PTSenR™

Smart Grid IIoT Sensing

POWER TECHNOLOGIES
24x7 PREDICTIVE HOTSPOT DETECTION IN CRITICAL LV & HT ELECTRICAL INFRASTRUCTURE
WORLD SMALLEST IP68 ENERGY HARVESTING TEMPERATURE WIRELESS IOT SENSORS

Presenter: Ray Khan

POWER TECHNOLOGIES™ Private Limited

Global Compact Network Singapore

SINGAPORE ELECTRICAL CONTRACTORS & LICENSED ELECTRICAL WORKERS ASSOCIATION

POWER TECHNOLOGIES™ Private Limited

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Decoding
Input Mode QRS
Data Purge: Sector 0010
Online Data Feed
AAM
ACS
OTA
5376 843950 35207
scanning
5376 84395 0 35207
9298 9501 34 04050
DISTANCE TO TARGET 5376 84395 0 35207
ETA TO TARGET 9298 9501 34 04050
9,157
SECTOR : 91
04
SECTOR : 82
79
SECTOR : 70
79
ACS -628
OCS -719
V-CH -528

3rd Party Certification – Reliability & Performance

SGS

Reference No. VoC-RoHS: CN/23/10192/VoC

Issue Date: 2023-11-10

VERIFICATION OF CONFORMITY for RoHS Directive (2011/65/EU)

Product	:	Self-powered wireless temperature sensor
Test requested by	:	Power Technologies Private Limited
Name and address of the manufacturer	:	Power Technologies Private Limited 61 Kaki Bukit Avenue 1 #05-02 Shun Li Industrial Park, Singapore 417943
Name and address of the factory	:	Same as above
Trade mark	:	
Model/Identification	:	PTSPS061; PTSPD4000W; PTSPS068; PTSPS071; PTSPS020; PTSPS090; PTSPS086
Conclusion	:	The assessed sample made available complies with the limits of Pb, Hg, Cd, Cr (VI), PBB, PBDE, DEHP, BBP, DBP, DIBP as set by RoHS Directive (EU)2015/863 amending Annex II to Directive 2011/65/EU.
Sufficient samples of the product have been analysed according to the following scope	:	Pb, Hg, Cd, Cr (VI), PBBs, PBDEs, DEHP, BBP, DBP, DIBP according to standard IEC 62321-1: 2013, IEC 62321-2: 2021, IEC 62321-3-1: 2013, IEC 62321-4: 2013+A1: 2017, IEC 62321-5: 2013, IEC 62321-6: 2015, IEC 62321-7-1: 2015, IEC 62321-7-2: 2017 & ISO 17075-1: 2017, IEC 62321-8: 2017
As shown in the report	:	SHAEC23000003003
Date of expiry	:	2024-11-09

This Verification of Conformity is based on analysis of the product, component or material and verifying the documentation being in accordance with the provisions of the Directive (EU)2015/863 amending Annex II to Directive 2011/65/EU on the restriction of the use of certain hazardous substances in electrical and electronic equipment. It does not imply an assessment of the production. No amounts above the limits of these substances have been detected or if so specific exemptions are applicable. This result relates only to the item(s) tested. Other CE marking directives may apply but have not been considered during the RoHS assessment.

This Verification of Conformity does not give the right to use any SGS mark on products, components or materials, their packaging or any marketing material or activities.

The CE mark can be used under the responsibility of the relevant finished-product manufacturer, after completion of an EU Declaration of Conformity and compliances with all relevant EU Directives.

Authorized Signatory

Mingjie Zhu
Project Manager
SGS-CSTC

This verification is issued by the company under its General Conditions of Services accessible at https://www.sgs.com/en/terms-and-conditions. Attention is drawn to the limitations of liability defined therein and in the Test Report here above mentioned which findings are reflected in this verification. Any unauthorized alteration, forgery or falsification of the content or appearance of this document is unlawful and offenders may be prosecuted to the fullest extent of the law.

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COMPLIANCE

SGS-CSTC Standards Technical Services Co.,Ltd.

SGS

VERIFICATION OF COMPLIANCE

Verification No.:	SHCR231100242501HSC
Applicant:	Power Technologies Private Limited
Address of Applicant:	61 Kaki Bukit Avenue 1 #05-02 Shun Li Industrial Park, Singapore 417943
Product Description:	Wireless temperature sensors
Model No.:	PTSPS061
Sufficient samples of the product have been tested and found to be in conformity with	
Test Standards:	EN 300 220-1 V3.1.1 EN 300 220-2 V3.1.1 EN 301 489-1 V2.2.3 EN 301 489-3 V2.3.2 EN 62479:2010
As shown in the Test Report Number(s):	SHCR231100242501 SHCR231100242502 SHCR231100242503

Conclusion
Based on a review of the test report(s) detailed above, this apparatus meets the requirements of above standards. The product is in conformity with the essential requirements of Article 3.1 (a) the protection of the health, 3.1 (b) an adequate level of electromagnetic compatibility and 3.2 effective use of the spectrum of 2014/53/EU.
The CE mark as shown below can be used, under the responsibility of the manufacturer, after completion of an EU Declaration of Conformity and compliance with all relevant EU Directives.

CE

Parlam Zhan
Laboratory Manager

Date: 2024-01-03

SGS-CSTC Standards Technical Services Co. SGS C&P EEC

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EMC-VOC-F001
Rev03/Effective Date :2021-09-07
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COMPLIANCE

SGS-CSTC Standards Technical Services Co.,Ltd.

SGS

VERIFICATION OF COMPLIANCE

Verification No.:	SHCR231100242401HSC
Applicant:	Power Technologies Private Limited
Address of Applicant:	61 Kaki Bukit Avenue 1 #05-02 Shun Li Industrial Park, Singapore 417943
Product Description:	Wireless temperature sensors
Model No.:	PTSPS061
Sufficient samples of the product have been tested and found to be in conformity with	
Test Standards:	EN IEC 61326-1: 2021
As shown in the Test Report Number(s):	SHCR231100242401

This verification of EMC Compliance has been granted to the applicant based on the results of the tests, performed by laboratory of SGS-CSTC Standards Technical Services Co., Ltd. on the sample of the above-mentioned product in accordance with the provisions of the relevant specific standards under Directive 2014/30/EU. The CE mark as shown below can be used, under the responsibility of the manufacturer, after completion of an EU Declaration of Conformity and compliance with all relevant EU Directives.

CE

Parlam Zhan
Laboratory Manager

Date: 2024-01-03

SGS-CSTC Standards Technical Services Co. SGS C&P EEC

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EMC-VOC-F009
Rev02/Effective Date :2021-09-07
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POWER TECHNOLOGIES™ Private Limited

Content

Standards & Codes

Content

Standards & Codes

- SS628 Singapore Standards for Electrical Installation
- SCDF (Singapore Civil Defence Force) Requirement
- SS538 Singapore Standards for Electrical Maintenance
- Green Mark 2021 (Singapore Environmental Sustainability Legislative Framework)

Singapore Standards Code of Practice for Electrical Installation SS638: 2018

526 Electrical connections

526.1 Every connection between conductors or between a conductor and other equipment shall provide durable electrical continuity and adequate mechanical strength and protection.

NOTE – See 522.8 – Other mechanical stresses.

526.2L The selection of the means of connection shall take account of, as appropriate:

(i) the material of the conductor and its insulation

(ii) the number and shape of the wires forming the conductor

(iii) the cross-sectional area of the conductor

(iv) the number of conductors to be connected together

(v) the temperature attained at the terminals in normal service such that the effectiveness of the insulation of the conductors connected to them is not impaired

(vi) the provision of adequate locking arrangements in situations subject to vibration or thermal cycling.

Notes:

SS638 emphasizes the significant importance of temperature measurement at connection/terminal in electrical installations

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Singapore Standards Code of Practice for Electrical Installation SS638: 2018

526.4 Where necessary, precautions shall be taken so that the temperature attained by a connection in normal service shall not impair the effectiveness of the insulation of the conductors connected to it or any insulating material used to support the connection. Where a cable is to be connected to a bare conductor or busbar its type of insulation and/or sheath shall be suitable for the maximum operating temperature of the bare conductor or busbar.

Notes:

SS638 emphasizes the significant importance of temperature measurement at connection/terminal in electrical installations

Standards & Codes

- SS628 Singapore Standards for Electrical Installation
- SCDF (Singapore Civil Defence Force) Requirement
- SS538 Singapore Standards for Electrical Maintenance
- Green Mark 2021 (Singapore Environmental Sustainability Legislative Framework)

A Singapore Government Agency Website How to identify

SCDF The Life Saving Force

Who We Are | Fire Safety | Civil Defence Shelter | NS Matters | Community & Volunteers | Join Us | E-Services

Please be informed that Bukit Batok Fire Station will not be hosting the weekly Saturday Fire Station Open House from 30 Sep 2023 to Feb 2025. Please refer to the list of other Fire Stations that are available for visits. 1/5

Hotlines 995 Fire Engine/ Ambulance 1777 Non-Emergency Ambulance Fire Hazard Reporting 1800 280 0000 General Enquiries 1800 286 5555

home page > Fire Code 2023 > Codes & Standards

Notes:
SCDF Code & Standards Did mention the requirement of Compliance with SS638

STANDARDS AND CODES

TABLE 1.2A : CODES & STANDARDS		
Name	**Description**	**Remarks**
SINGAPORE STANDARDS		
SS CP 5	CoP for Wiring of Electrical Equipment of Buildings	Replaced by SS 638

SCDF
The Life Saving Force
. . . for a safer Singapore

FSM Briefing 2022: Fire Statistics and Case Studies

28 July 2022

MAJ Huang Weikang, Senior Fire Investigator, SCDF

Souce: https://www.scdf.gov.sg/firecode2023/firecode2023

Fire Safety Tips

Loose / Improper Connection

- Increase resistance in the circuit.
- High resistance causes overheating.
- Arcing may occur with frequent making / breaking of contacts.
- May ignite the conductors or nearby combustibles.

Have a Licensed Electrical Worker to perform regular Checks/ Servicing

Souce: https://www.scdf.gov.sg/firecode2023/firecode2023

Notes:

SCDF emphasizes the significant importance of Loose/ Improper Connections resulting to Overheating & the importance of "Regular Checks"

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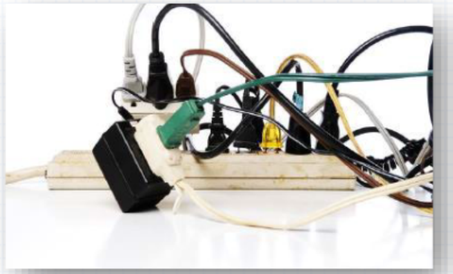
Fire Safety Tips

Overloading

- Occurs when current exceeds rated capacity.
- Excessive current can cause heating, melting and insulation damage to the wires/cables, possibly starting a fire.
- May ignite the conductors or nearby combustibles.



Never overload electrical outlets with Electrical appliances

CASE STUDIES & SAFETY TIPS

Souce: https://www.scdf.gov.sg/firecode2023/firecode2023

Notes:

SCDF emphasizes the significant importance of monitoring excessive current resulting to heat & possible fire

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Case Study #3

Power Supply Room Fire

- Fire involved the contents of an electrical distribution box.
- Although fire was confined to the distribution box, there were power disruptions to sections of the mall which resulted in the evacuation of public.
- Prompt actions by CERT helped in the prevention of fire spread and the safe evacuation of public.

CASE STUDIES & SAFETY TIPS

Notes:

SCDF emphasizes the significant importance of fire prevention in any form of "Electrical Distribution Box"

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Standards & Codes

- SS628 Singapore Standards for Electrical Installation
- SCDF (Singapore Civil Defence Force) Requirement
- SS538 Singapore Standards for Electrical Maintenance
- Green Mark 2021 (Singapore Environmental Sustainability Legislative Framework)

Singapore Standards Code of Practice for Maintenance of Electrical Equipment
SS538: 2008

1.1 Scope

1.1.1 Object

<u>This Code covers the maintenance of electrical equipment for voltages up to and including 22 kV</u>
to enhance safe and proper operation of electrical installations with reduced risk of breakdown and the consequent interruption of supply. It represents a standard of good practice and therefore takes the
form of recommendations for the maintenance

Singapore Standards Code of Practice for Maintenance of Electrical Equipment
SS538: 2008

1.1.3 Responsibility

The Owner/Proprietor shall primarily be responsible to maintain reliable performance of their electrical equipment with advice and assistance from Licensed Electrical Worker. It is the responsibility of Owner/Proprietor to engage a licensed electrical worker of the appropriate class to secure a license and take charge of his electrical installation. No person other than the licensed electrical worker shall be permitted to operate the electrical installation.

Singapore Standards Code of Practice for Maintenance of Electrical Equipment
SS538: 2008

General inspection on Switch room

1. cleanliness,
2. lighting,
3. humidity,
4. ventilation,
5. evidence of overheating
6. audible discharge
7. Leakage of oil or compound
8. unusual burn/gaseous smell
9. accumulation of water
10. crack in the walls & ceilings
11. Earth connection

Access

- Only Authorized Person

(A licensed electrical worker of the appropriate class appointed by the Owner/Proprietor to secure a license where applicable, carry out work on the electrical installation and take charge of the electrical installation.)

Notes:

SS538 Has precisely outlined 11 key inspection areas within a switchroom

Singapore Standards Code of Practice for Maintenance of Electrical Equipment
SS538: 2008

- **1.6.2.2 Routine maintenance**

The intervals between maintenance operations may be based on the number of operations performed by the switchgear and controlgear as recommended by the manufacturer, or on fixed time intervals, taking into account the duty that they are called upon to perform and the environment in which they

are situated.

Measurements of insulation resistance will give a good indication of the condition of the insulation of the switchgear and

controlgear and should be carried out regularly and recorded

Partial discharge test is recommended for 6.6 kV and 22 kV switchgear and controlgear.

Continuous Online Partial Discharge Sensor

Notes:
SS538 emphasizes the significant importance of Partial Discharge test for 6.6kV & 22KV Switchgears

Singapore Standards Code of Practice for Maintenance of Electrical Equipment
SS538: 2008

- **1.6.3 Records**

Records are of value in establishing the frequency of maintenance. Therefore careful note should be taken of relevant items each time maintenance is performed. Record should be initiated when the equipment is installed and should contain at least the following information:

a) Manufacturer's details, including nameplate particulars of the equipment installed, its serial number and manufacturer's order number (if known) and the date of installation;

b) Place where the manufacturer's handbook and list of recommended spare parts can be found;

c) Date of last maintenance operation and note of the operation counter reading at that time, or an estimate of the number of operations;

Notes:
SS538 emphasizes the significant importance of records keeping & finding of electrical equipments

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Singapore Standards Code of Practice for Maintenance of Electrical Equipment
SS538: 2008

d) Type of maintenance carried out;

e) Record of any findings where the condition of the equipment varied from the expected, action taken and the condition of important components when the equipment was put back in service;

f) Details of fuse-link type and ratings, and relay settings;

g) Details of the maximum system fault levels, and any changes to them.

Wireless HMI With Event Records

Monitor Sys.
Index Cabinet Name Location Sensor ID Control Word Value Time/Date Description
46733 A003 cable-Phase C 51709138 2-Node Temp. 10.0 17:33:35 2021-05-17 Unbal. (p)
46732 A003 cable-Phase A 48693257 2-Node Temp. 10.0 17:33:35 2021-05-17 Unbal. (p)
46731 A003 cable-Phase A 48693257 2-Node Temp. 135.4 17:33:35 2021-05-17 T. Diff.
46730 A003 busbar-Phase C 48693256 2-Node Temp. 98.7 17:33:34 2021-05-17 Unbal.
46729 A003 busbar-Phase A 14811145 2-Node Temp. 98.7 17:33:34 2021-05-17 Unbal.
46728 A003 busbar-Phase A 14811145 2-Node Temp. 164.3 17:33:34 2021-05-17 T. Diff.
46727 A003 busbar-Phase A 14811145 2-Node Temp. 32.1 17:33:34 2021-05-17 T. Diff.
46726 A003 busbar-Phase A 14811145 2-Node Temp. 128.7 17:33:34 2021-05-17 Node T.
46725 A003 Lowercontact-Phase C 502146 2-Node Temp. 35.7 17:33:33 2021-05-17 Unbal.
46724 A003 Lowercontact-Phase A 502144 2-Node Temp. 35.7 17:33:33 2021-05-17 Unbal.
Clear Pre-Alm
Clear Alarm
Page: 1/4674
Up
Down

	A	B	C	D	E	F	G	H	I
1	Date	Time	VR PHASE-	VY PHASE-	VB PHASE-	R CURREN	Y CURREN	B CURREN	P IN W-1
2	########	12:27:20	230.6865	226.6355	228.5364	2.00E-17	1.543297	2.662969	919.0203
3	########	12:27:21	230.7051	226.6355	228.597	2.00E-17	1.543297	2.663748	919.2084
4	########	12:27:22	230.7381	226.6696	228.6276	2.00E-17	1.543445	2.664346	919.4232
5	########	12:27:23	230.7381	226.6864	228.6594	2.00E-17	1.543882	2.664346	919.6585
6	########	12:27:24	230.7577	226.6962	228.6982	2.00E-17	1.543852	2.664626	919.8068
7	########	12:27:25	230.7739	226.7084	228.7299	2.00E-17	1.543431	2.664412	919.7638
8	########	12:27:26	230.7859	226.7196	228.7481	2.00E-17	1.543332	2.665387	920.0334
9	########	12:27:27	230.7878	226.7343	228.7717	2.00E-17	1.543385	2.665798	920.2397
10	########	12:27:28	230.8028	226.7466	228.8006	2.00E-17	1.543191	2.665813	920.2397
11	########	12:27:29	230.8133	226.7505	228.8006	2.00E-17	1.542834	2.665813	920.2905
12	########	12:27:30	230.8073	226.7505	228.8353	2.00E-17	1.542834	2.665469	920.1999
13	########	12:27:31	230.8073	226.7646	228.8599	2.00E-17	1.543164	2.665342	920.2798
14	########	12:27:32	230.8145	226.7858	228.8822	2.00E-17	1.542983	2.665111	920.3278
15	########	12:27:33	230.8181	226.8064	228.9079	2.00E-17	1.543303	2.665259	920.558
16	########	12:27:34	230.8254	226.8214	228.9277	2.00E-17	1.543163	2.665202	920.6186
17	########	12:27:35	230.8303	226.8408	228.9462	2.00E-17	1.543472	2.665429	920.8184
18	########	12:27:36	230.8225	226.8573	228.9649	2.00E-17	1.54337	2.665417	921.0901
19	########	12:27:37	230.825	226.8644	229.0018	2.00E-17	1.543421	2.665417	921.0901

Historical Event Records in excel format

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Singapore Standards Code of Practice for Maintenance of Electrical Equipment
SS538: 2008

2.3.2.1 Routine maintenance

In general, frequency of maintenance shall follow Table 1.1.

All newly installed switchgear should be examined prior to commissioning, and inspected or examined within 12 months of commissioning. It is also advisable to inspect all equipment shortly before the expiry of the manufacturer's warranty. These inspections and examinations can give guidance on the necessary frequency of maintenance. The inspection and examination should include partial discharge measurement and infra-red hot-spot scanning before the total shut-down of the switchgear installation.

Continuous Wireless
Online Partial Discharge
Measurement Sensor

Continuous Wireless
Hot Spot Scanning Sensor

Self-Powered Wireless Hot
Spot Sensor

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Singapore Standards Code of Practice for Maintenance of Electrical Equipment
SS538: 2008

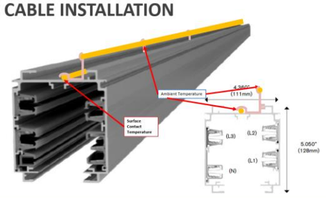
2.3.17 Busbars and busbar chambers

Air insulated busbar chambers should be examined, as far as is reasonably practicable, for signs of overheating and for deterioration of the insulation. Open type busbars can be scanned with infra-red detection equipment in order to detect any hot spots which are caused by high resistance connections.

Compound and oil-filled busbar chambers should be inspected for leakage. Insulation can be checked as detailed in 2.3.7.

Sulphur-hexafluoride-filled busbar chambers which are giving satisfactory service should not be disturbed as contamination might be introduced during examination. Following maintenance, it is particularly important that an inspection is made to ensure that loose components, tools or wires are not left in the vicinity of the busbars which could subsequently cause a fault.

FO CABLE INSTALLATION



Notes:

SS538 emphasizes the significant importance of hot spot detection on Busbars

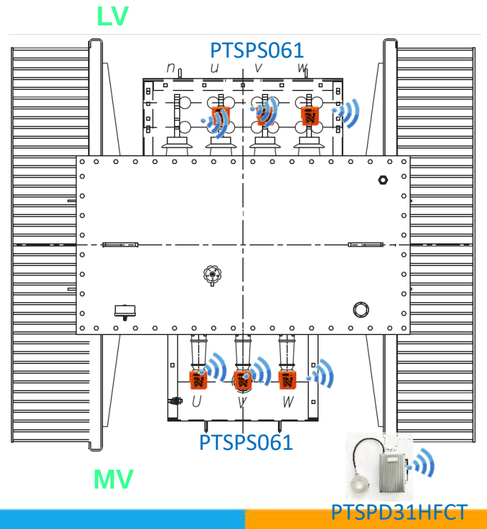
Singapore Standards Code of Practice for Maintenance of Electrical Equipment
SS538: 2008

3.2.4 Maintenance programmed for liquid-filled transformer

3.2.4.2 Inspection locations

During the transformer maintenance, the ventilation of the room shall be checked including the mechanical forced air cooling. All connections should be inspected for signs of overheating and corrosion. The observations can be on-line when the transformer is operating or off-line when the transformer is switched off. Insulators and the insulating surfaces of bushings should be inspected for tracking, cracks or chipped skirts and the gasket bases for leaks

Self-Powered Wireless Temperature Sensor



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Singapore Standards Code of Practice for Maintenance of Electrical Equipment SS538: 2008

Notes:
SS538 emphasizes the significant importance of "predictive" maintenance On HV Equipments

4.3.2 Testing methods on predictive maintenance of high-voltage power cables

The testing methods of predictive maintenance as shown below are to detect the abovementioned discharges on the power cables or terminations. There are more methods available but they have to be economically viable and practical before they can be used.

a) Transient earth voltage partial discharge detection (frequency in the range up to 100 MHz)

For void discharge within the insulation of cable, the transient earth voltage partial discharge detection equipment is used to detect the source of the discharge. The readings obtained are compared with values for the earthed metal to detect the severity of the discharge. The source of discharge can be detected by comparing with the adjacent healthy panels.

b) Acoustic frequency partial discharge detection (frequency in the range up to 100 kHz)

The partial discharge equipment for this range of frequency is to detect any tracking or any resultant corona that caused the air particles surrounding the cable termination to vibrate. This type of detection is considered more severe as compared to the MHz range as the tracking is formed. Equipment may need to be shut down for investigation if there is any partial discharge detected for this range of frequency.

c) Thermography

Infra-red scanning, where practicable, without removing any cover which can compromise safety is used to detect excessive heat caused by high contact resistance, e.g. loose connection, partial discharge, etc. As the readings are affected by the load current, they are normally compared with values for the adjacent panels, or with historical data to detect any abnormality.

Continuous Wireless Online Partial Discharge Measurement Sensor

Continuous Wireless Hot Spot Scanning Sensor

Self-Powered Wireless Temperature Sensor

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Singapore Standards Code of Practice for Maintenance of Electrical Equipment
SS538: 2008

Notes:
SS538 emphasizes the significant importance of loose connections or overheating in connections on the maintenance of Circuit Breakers

5.4 Maintenance of circuit breakers

5.4.7 Inspection and cleaning

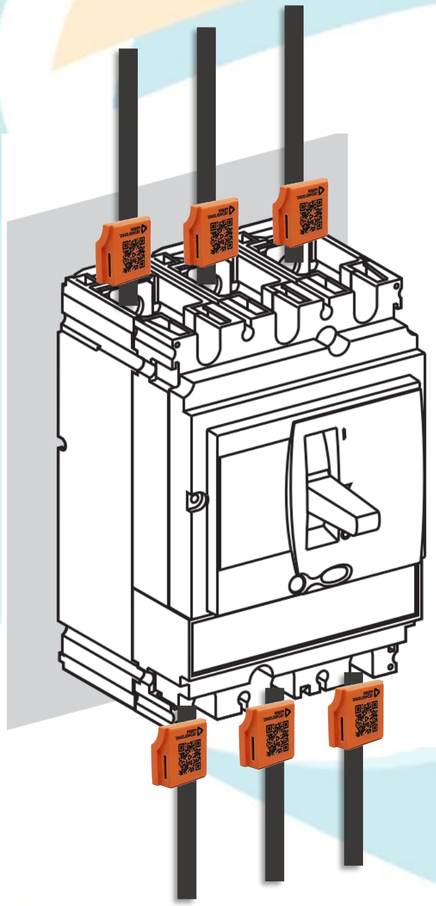
Circuit breakers shall be kept free from external contamination for proper heat dissipation and reduction of potential arcing. The case shall have adequate structural strength to withstand the stresses during fault-current interruptions. Hence, visual inspection for cracks in the case should be carried out during maintenance.

5.4.8 Loose connections

Checks for loose connections or evidence of overheating shall be carried out during periodic maintenance. Loose connections should be tightened to the manufacturers' recommended torque. All connections should be maintained in accordance with manufacturer's recommendations.

Self-Powered Wireless
Temperature Sensor

Continuous Wireless
Hot Spot Scanning Sensor



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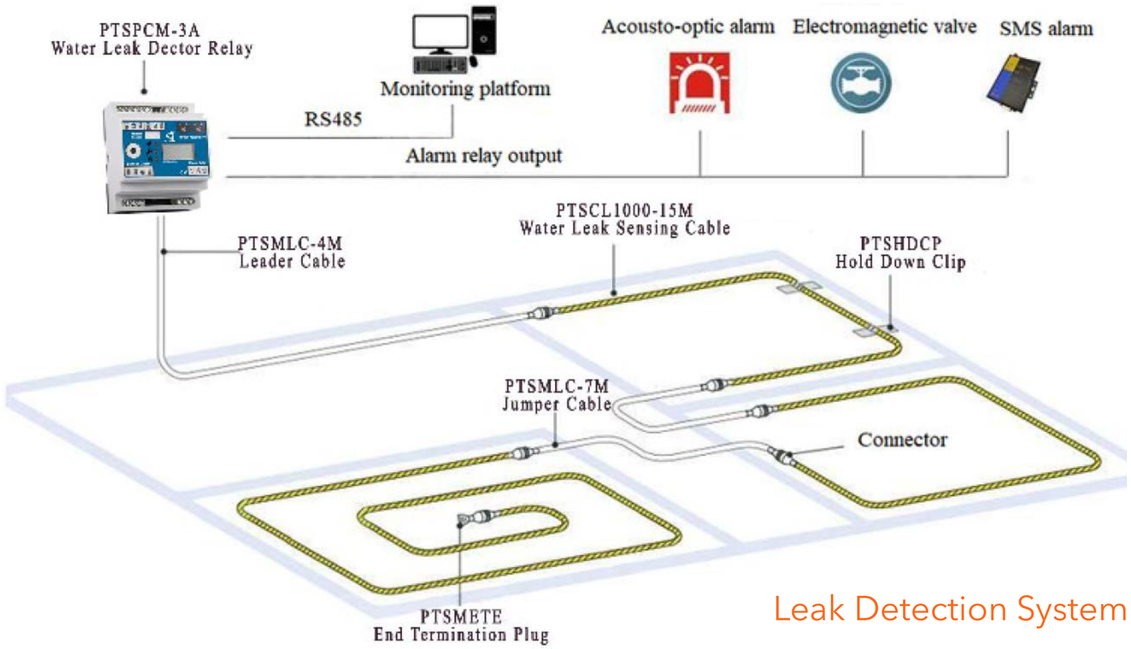
Singapore Standards Code of Practice for Maintenance of Electrical Equipment
SS538: 2008

Notes:
SS538 emphasizes the significant importance of Moisture and Leakage and routine inspection is required

1.4.13 Moisture and contamination

Moisture is always a potential danger. Temperature variations which occur in the switchroom may result in condensation due to high humidity. This moisture coupled with dirt and dust may lead to electrical breakdown. Preventive measures may include sealing of unnecessary openings and installation of dehumidifiers or heaters. Routine inspection should include verification that such devices are functioning properly.



Leak Detection System

Leakage Controller

Water Sensing Cable

Oil Sensing Cable

Wireless Humidity Sensor

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Standards & Codes

- SS628 Singapore Standards for Electrical Installation
- SCDF (Singapore Civil Defence Force) Requirement
- SS538 Singapore Standards for Electrical Maintenance
- Green Mark 2021 (Singapore Environmental Sustainability Legislative Framework)

Green Mark 2021

Green Mark 2021

The refreshed Green Mark 2021 (GM: 2021) certification standards and technical guides are uploaded below as the 2nd edition. Starting from 1 June 2024, all projects will be assessed using the documents under the 2nd edition, including ongoing projects with application submitted before 1 June 2024.

Green Mark 2021

Green Mark 2021 applies to new and existing buildings including commercial buildings, industrial buildings, institutional buildings and residential buildings. The criteria and scoring framework can be downloaded below.

- GM: 2021 Certification Standard
- GM: 2021 In-Operation (Non-Residential)
- GM: 2021 In-Operation (Residential)
- GM: 2021 Energy Efficiency
- GM: 2021 Carbon Section
- GM: 2021 Resilience Section
- GM: 2021 Intelligence Section
- GM: 2021 Health & Wellbeing Section
- GM: 2021 Maintainability Section
  - Mt Framework (NRB)
  - Mt Framework (RB)
  - Mt Framework (ENRB)

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Building and Construction Authority

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Green Mark 2021

Detailing	4.2.3	Reduce risk of failure of main LT switchboard due to overheating (1 point)	Points Available	Points Scored
	a.	Install heat sensor in the main LT switchboard to alert any abnormal rise in temperature with audible/visual alarm.	0.5 (Cat 1)	
	b.	Integrate sensor to building BMS system for online monitoring of temperature data.	0.5 (Cat 1)	

Notes:

GM2021 emphasizes the significant importance of

a) installing heat sensors at LT Switchboard

b) Integrate sensors for BMS for online monitoring of "temperature" data

Green Mark 2021

Maintainability Framework

For New Non-Residential Buildings (NRB)

Self-Powered Wireless Temperature Sensor

Continuous Online Partial Discharge Monitoring

Wireless Infrared Sensor

Wireless Humidity Sensor

Statistics and Finding

NFPA – Statistic Accident

Without operator

25%

Nobody present in the switchroom.

Faults happens on each type of switchgear but **the impact is different** !

With operator

75%

Compartments closed

Compartments opened

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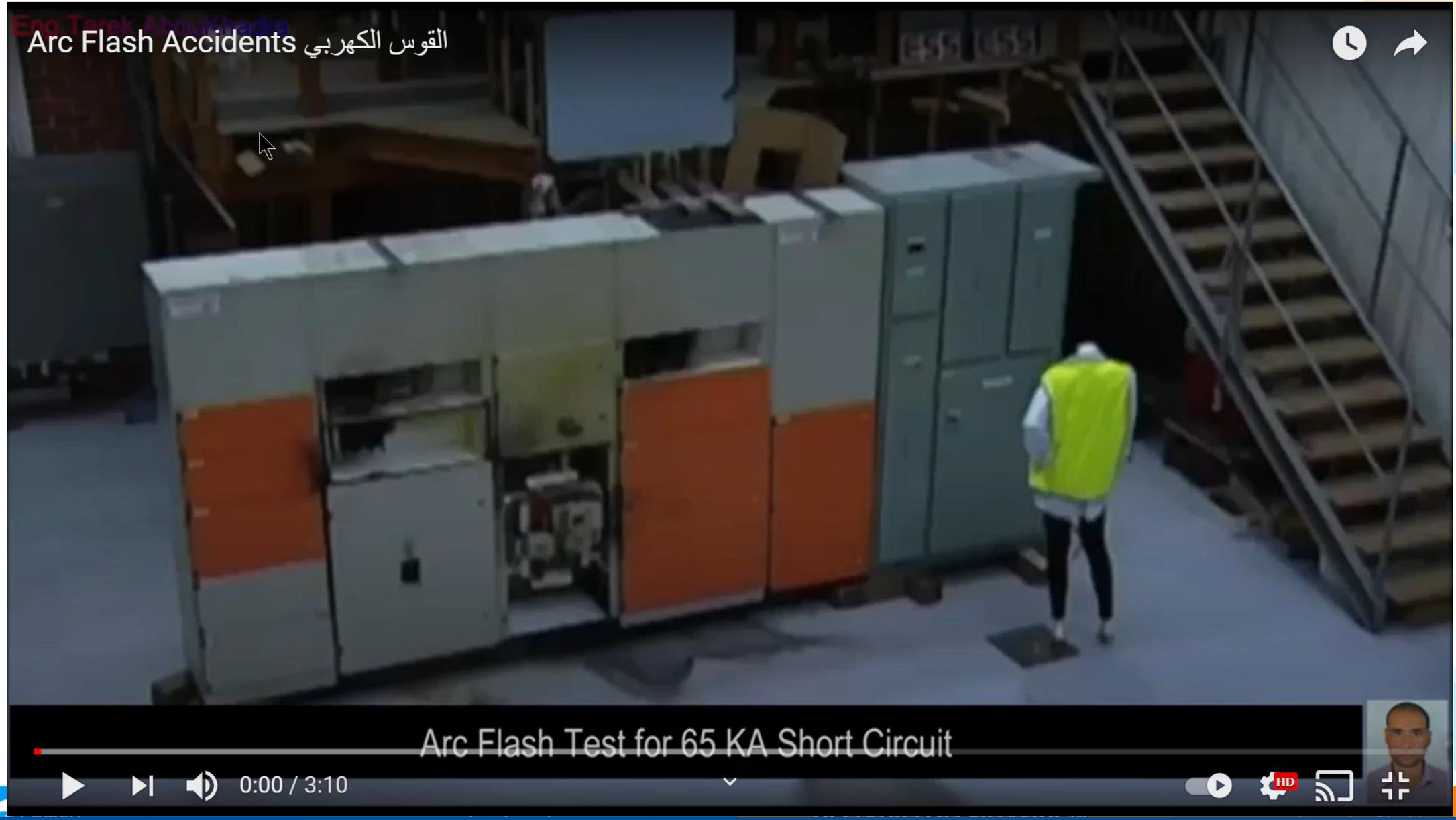
Electrical Preventive Maintenance

- However, how often many substations, infrastructures, data centers or buildings carry out thermal scan or partial discharge monitoring?

1. Once in every 6 months?
2. Once yearly?
3. Once every 2 years?
4. Automated and Real-time Monitoring?
5. Never?

INTERNATIONAL ELECTRICAL TESTING ASSOCIATION INC
NETA
NETA "major insurance carrier estimates 35-40% of all major electrical failures are due to loose or faulty connections...".

It Do Happens – Real Incident “LIVE”



It Do Happens – Real Incident “LIVE”

What & Why Predictive Monitoring System?

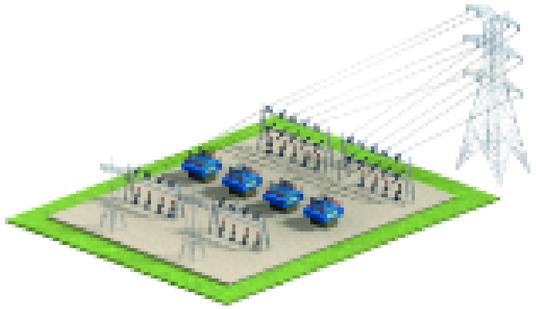
Temperature & Partial Discharge monitoring helps with the following tasks:

1. Determine the **overall health** of the equipment
2. Monitor the degradation **trend** of the equipment
3. **Prediction** of future equipment malfunction
4. Plan for **OPEX** and **CAPEX**

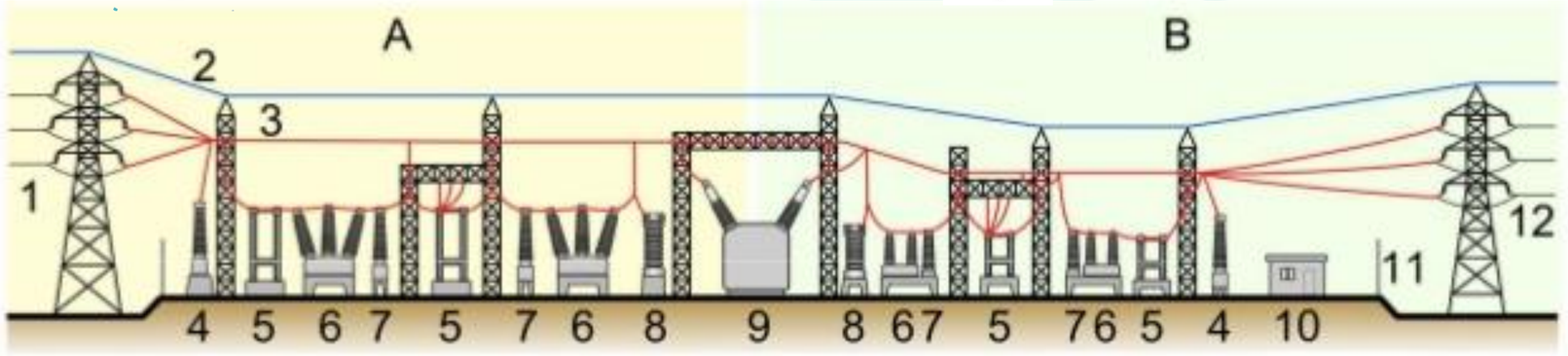
POWER TECHNOLOGIES™ Private Limited

Technology and Solutions

PTSenR™ - The Complete GRID Solutions



PTSPS070 PTSPS090 PTSPS061 PTSPS096 PTSPS116 PTSPW3100 PTSGL1



1.Primary power lines 2.Ground wire 3.Overhead lines 4.Transformer for measurement of electric voltage 5.Disconnect switch 6.Circuit breaker 7.Current transformer 8.Lightning arrester 9.Main transformer 10.Control building 11.Security fence 12.Secondary power lines

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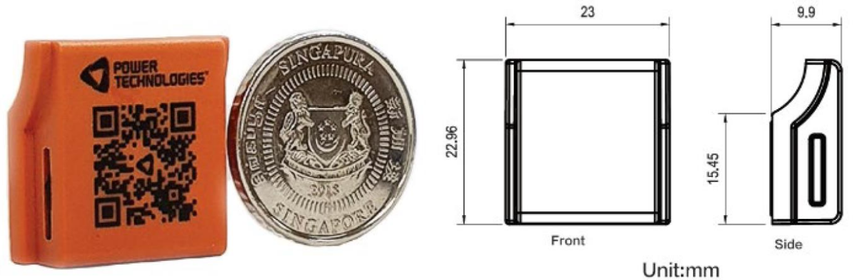
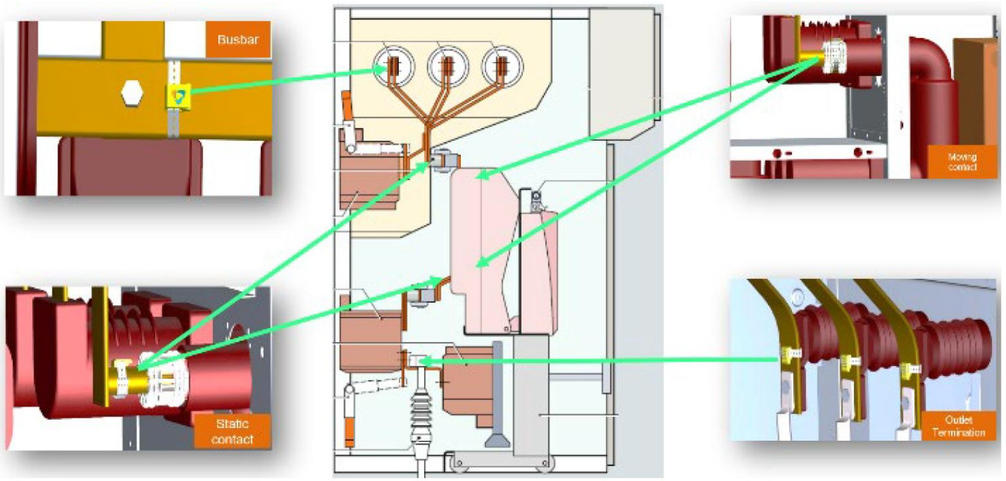
PTSPS061 Self-Powered Wireless Temperature Sensor

Dimensions





Specification

Power Supply Input Voltage	Voltage Free & Battery Free
Energy Harvesting	≤5A ~ 6000A
Operational Voltage	110V ~ 500kV (VAC)
Wireless Operating Bandwidth	433MHz (Zigbee)
Transmission Power	10dBm
Wireless Transmission Distance	0.4 ~ 20 meter (enclosed) / 500meter (open space)
Communication rate	10 kbps
Temperature measurement type	Direct Contact-type
Relative Humidity (RH)	≤95%RH (non-condensing)
Storage Temperature	-40°C ~ 85°C
Operating Temperature	-40°C ~ 85°C
Temperature measuring range	-40 ~ 125°C
Measurement accuracy	±1.0°C
Measurement interval	10 sec
Transmission interval	20 to 100 seconds, the higher the temperature of the sudden change, the shorter the transmission interval
Protection level (IP)	IP68
Flame retardant grade	V0 (700°C 30 Sec)
Service life	≥20 years
Certification 2014/35/EU LOW VOLTAGE DIRECTIVE; 2014/30/EU ELECTROMAGNETIC COMPABILITY DIRECTIVE	CE – EN 61000-6-2:2005+AC; EN 61000-6-4:2007+A1:2011; EN 62366-1:2014+A11:2017

Index of Ingress Protection

Protection against Solid Bodies

0	No protection
1	Protected against solid bodies of 50mm and greater, (e.g. accidental contact with the hand)
2	Protected against solid bodies of 12.5mm and greater, (e.g. accidental touch by fingers)
3	Protected against solid bodies of 2.5mm and greater, (e.g. tools and wires)
4	Protected against solid bodies of 1mm or greater, (e.g. thin tools and fine wires)
5	Protected against dust - limited ingress (no harmfull deposits)
6	Totally protected against dust (Dust-tight)

Protection against Liquids

0	No protection
1	Protected against vertically falling drops of water (condensation)
2	Protected against drops of water falling up to 15° from the vertical
3	Protected against drops of water falling up to 60° from the vertical
4	Protected against splashing water from all directions
5	Protection against jets of water from all directions
6	Protection against powerful jets of water from all directions
7	Protected against the effects of temporary immersion in water
8	Protected against the continuous effects of immersion in water having regard to specific conditions
9	IP69k Automotive standard DIN40050 signifies resistance to high pressure jets (up to 80bar) from any angle

IP Classification

The first digit stands for protection against solid bodies

The second digit stands for protection against water

IPxx suitability ratings are a system for classifying the degree of protection provided by enclosures of electrical equipment. The higher the number, the greater the degree of protection, in accordance with standards IEC 60529 and EN 60529.

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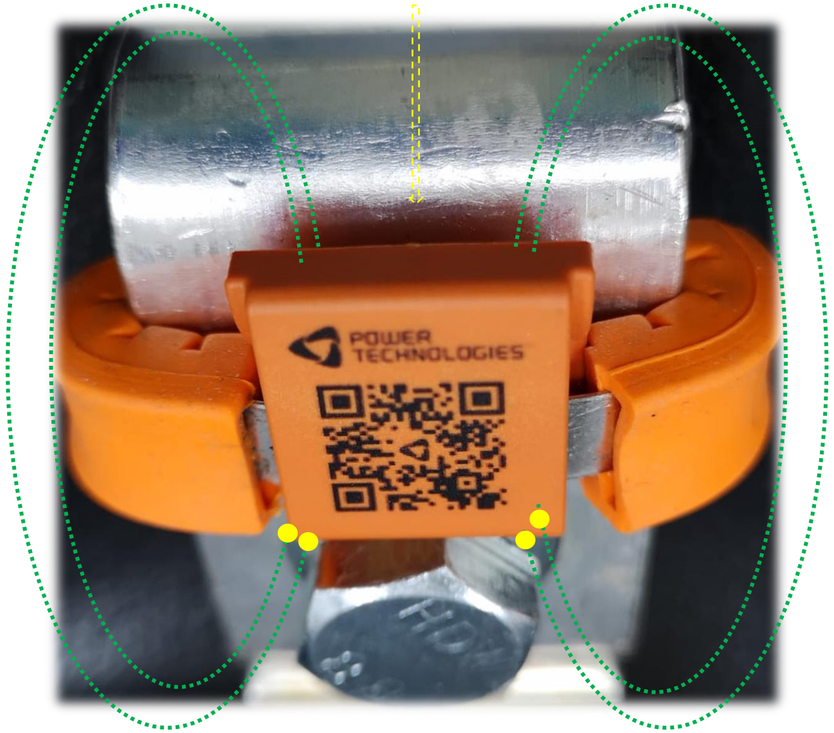
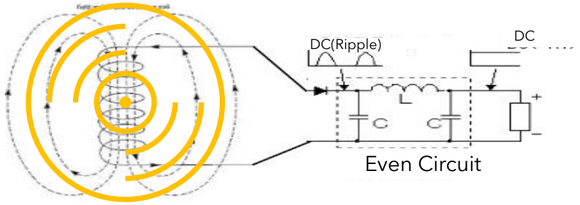
PTSenR™ Energy Harvesting Working Principle

Energy Harvesting





AC to DC power conversion

Ultra-low powered wireless transmitter & receiver

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Project Realization – PTSPS067 Infrared Sensor

Features

i. IP50
ii. V0 700˚C for 30 seconds
iii. Easy integration
iv. Lifetime calibrated
v. Fast + easy installation
vi. Detects faults before fail
vii. Energy Harvesting / Powered
viii. Continuous 24x 7 temperature monitoring
ix. Installed INSIDE electrical switchboards
x. Wide monitoring area FOV 90 ° x 90° (1024 monitoring point)

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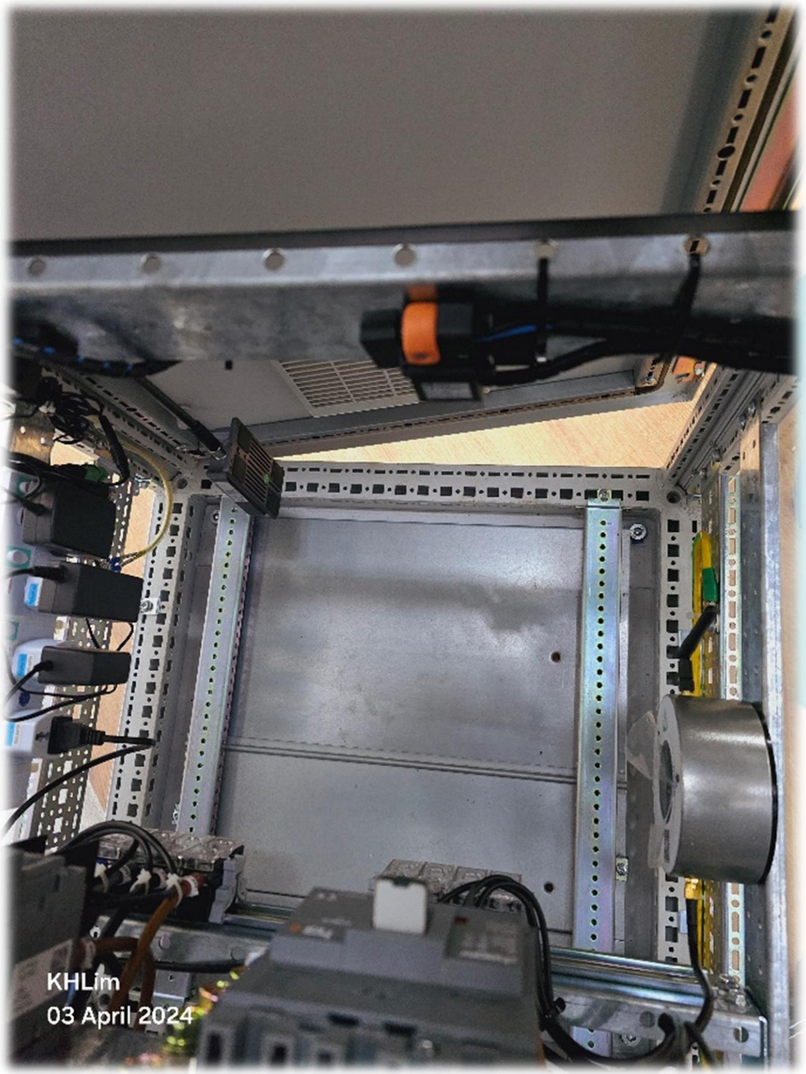
Project Realization – Infrared Sensor



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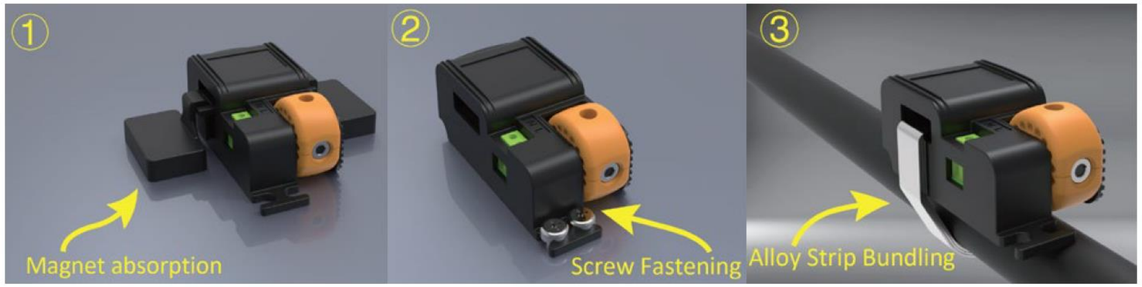
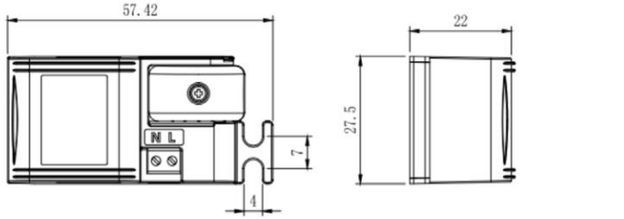
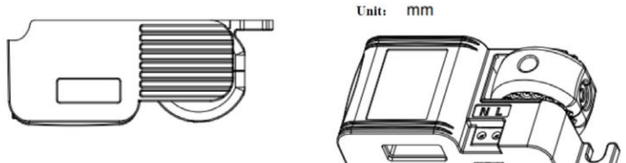
PTSPS067 Wireless Infrared Temperature Sensor

Installation



Dimensions



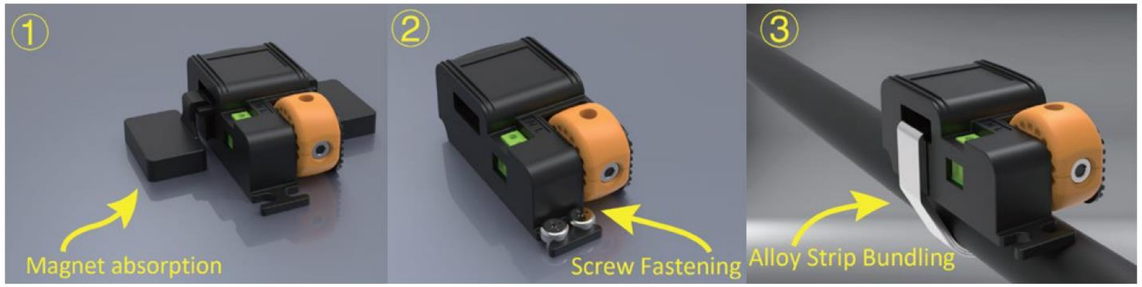


Specification

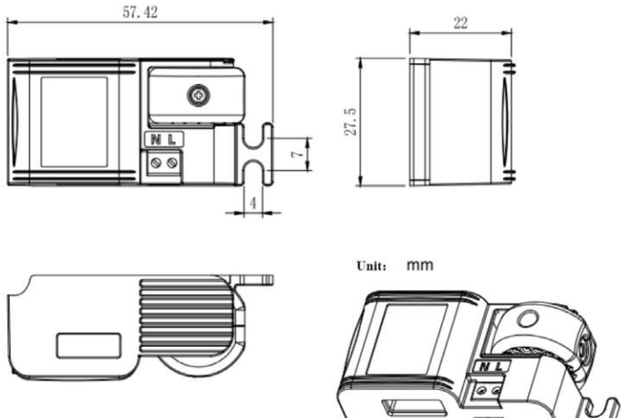
Temperature measurement type	Infrared
Focus Point	2.1mm
Aperture	f0.8
FOV	90° x 90°
Energy Harvesting (EH)	5A ~ 5000A
Operational Voltage	EH or 7.5Vac ~ 275Vac (direct) EH or 3.6Vdc (direct)
Wireless Operating Bandwidth	433MHz (Zigbee)
Transmission Power	10bBm
Wireless Transmission Distance	0 ~ 20 meter (enclosed) / 300meter (open space)
Altitude	≤4000m
Relative Humidity (RH)	≤95%RH (non-condensing)
Storage Temperature	-20°C ~ 65°C
Operating Temperature	-20°C ~ 65°C
Temperature measuring range	-20 ~ +200°C
Measurement accuracy	±5°C (Spacing 10cm)
Measurement Distance	<50cm
Transmission interval	30 to 120 seconds (the higher the temperature, faster the data sending)
Protection level (IP)	IP50
Flame retardant grade	V0 (700°C 30 Sec)
Service life	10 years
Installation Mode	Alloy Strip Bundling / Screw Fastening / Magnet absorption
Certification 2014/35/EU LOW VOLTAGE DIRECTIVE; 2014/30/EU ELECTROMAGNETIC COMPABILITY DIRECTIVE	CE – EN 61000-6-2:2005+AC, EN 61000-6-4:2007+A1:2011, EN 62366-1:2014+A11:2017

PTSPS067 Wireless Infrared Temperature Sensor

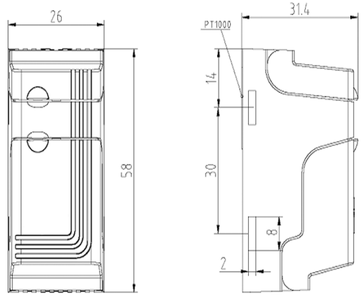
Installation



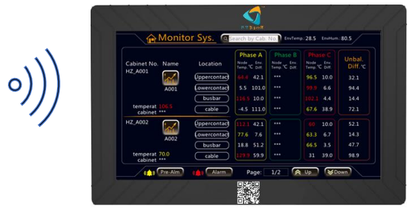
Dimensions



PTSPS068 Wireless Temperature and Humidity Sensor



- 3.6V Lithium Battery
- Battery Service Life 3~5 years (depend on transmission frequency)
- Service life 5 ~ 10 years
- Connect up to 100 PTSPS068 per HMI



Wireless Operating Bandwidth 433MHz / 2.4GHz
Wireless Transmission Distance 0 ~ 20 meter (enclosed) / 150meter (open space)

Specification

Power Supply Input	3.6V (14250) (High-capacity Li/SOCI2)
Operational Voltage	2.2V ~ 3.6V (DC)
Transmitting Current	<15mA
Standby Current	<3.0μA
Wireless Operating Bandwidth	433MHz / 2.4GHz (Zigbee)
Transmission Power	10dBm
Wireless Transmission Distance	0 ~ 20 meter (enclosed) / 150meter (open space)
Communication rate	10 kbps
Temperature measurement type	Direct Contact-type
Relative Humidity (RH)	≤95%RH (non-condensing)
Storage Temperature	-40°C ~ 85°C
Operating Temperature	-40°C ~ 85°C
Temperature measuring range	-40 ~ 125°C
Measurement accuracy	±1.5°C, ±4%RH(<80%RH); ±8%RH(≥80%RH)
Measurement interval	10 sec
Transmission interval	30 to 300 seconds, the higher the temperature of the sudden change, the shorter the transmission interval
Protection level (IP)	IP20
Flame retardant grade	V0 (700°C 30 Sec)
Service life	5 ~ 10 years
Battery Service Life	3~5 years (depend on transmission frequency)
Installation Mode	Tied / AB glue / Foamed glue / Magnet
Certification 2014/35/EU LOW VOLTAGE DIRECTIVE; 2014/30/EU ELECTROMAGNETIC COMPABILITY DIRECTIVE	CE – EN 61000-6-2:2005+AC; EN 61000-6-4:2007+A1:2011;

PTSPS114 Wireless Temperature and Humidity Sensor

DC operated Battery operated

Product Overview

The PTSenR PTSPS114 Wireless Temperature and Humidity Sensor is developed by our PT for the locations require to know the current temperature and humidity report in real-time, such as electrical cabinet, electrical box, monitoring room, stockroom, sus-station, transformer, storage area, data center, busduct, switchgear and etc.

Specification

Power Supply Input	9V-36V DC
Baud rate	9600
Operating Current	10mA
Standby Current	<3.0μA
Wireless Operating Bandwidth	433MHz (Zigbee)
Transmission Power	10dBm
Screen Specification	1.5-inch LCD screen
Method of Communication	ModbusRTU protocol
Temperature measurement type	Direct Contact-type
Relative Humidity (RH)	≤95%RH (non-condensing)
Humidity measurement Range	5%~100%RH
Humidity measurement accuracy	5~80%RH: ±4%, Others: ±5%.
Storage Temperature	-40°C ~ 85°C
Operating Temperature	-40°C ~ 85°C
Temperature measuring Range	-40 ~ 85°C
Temperature measurement accuracy	-10~70°C: ±0.5°C Others: ±1°C
Measurement interval	10 sec
Transmission distance	⩽800m (open)
Protection level (IP)	IP4X
Flame retardant grade	V0 (700°C 30 Sec)
Service life	3 years
Installation Mode	Magnetic type / Guide Rail type
Certification 2014/35/EU LOW VOLTAGE DIRECTIVE; 2014/30/EU ELECTROMAGNETIC COMPABILITY DIRECTIVE	CE – EN 61000-6-2:2005+AC; EN 61000-6-4:2007+A1:2011; EN 62366-1:2014+A11:2017

PTSPD4000W Continuous Online Partial Discharge Monitoring

Working Principle

UHF Method - Each PD process is accompanied by positive and negative power and a steep current pulse, radiating electromagnetic wave around it. The current pulse during PD inside the switch cabinet can be transmitted by electromagnetic waves with an internal excitation frequency of up to 500MHz to 1500MHz.

Ultrasonic Method - The spectrum of sound waves generated by local discharges is wide and can range from tens of Hz to several MHz ,where the frequency is less than 20kHz.

TEV Method - Transient ground power porter refers to the frequency of excitation in the ground housing and ground wire of electrical equipment due to local discharge Electromagnetic wave signal sequence between 3-100MHz.

Specification

Operation Supply	3.7V Lithium Battery / 24 VDC
Power Consumption	120mV
Type of Monitoring	Ultra-High Frequency **(UHF)** 500MHz to 1500MHz, Transient Ground Waves **(TEV)** 3MhZ to 100MHz, Ultrasonic **(AE)** 20k to 200kHz, Ambient Temperature **(T)** & Humidity **(RH)**
Operational Voltage	3.3kV ~ 40.5kV
Wireless Operating Bandwidth	433MHz, 2.4G (LORA)
Transmission Power	≤10dBm
Sampling Cycles	3Sec (Can be set)
Wireless Transmission Distance	≥300meter (open space)
Reception Sensitivity	5dBm
Security	SM1/SM7 Hard encrypted chips
Battery Service Life	2~3 years
Operating Temperature	-40°C ~ 85°C
Humidity	10~95%RH (non-condensing)
Protection level (IP)	IP54
Installation Mode	Magnetic suction, Nut type
Certification 2014/35/EU LOW VOLTAGE DIRECTIVE; 2014/30/EU ELECTROMAGNETIC COMPABILITY DIRECTIVE	CE – EN 61000-6-2:2005+AC, EN 61000-6-4:2007+A1:2011, EN 62366-1:2014+A11:2017

PTSPS075 Cable Temperature Sensor Systems

Features

6 individual cables sensor

Plug & play with built-in quick connect terminal blocks

- Linearize & conditions input signals to temperature values No external power
- Continuous 24x 7 temperature monitoring
- Installed Inside electrical switchboards
- Accurate
- Lifetime calibrated
- Fast + easy installation
- Secure direct to the various size lugs
- Detects faults before fail
- Easy integration

Specification

Power supply input voltage	AC220 ~794
Energy Harvesting	<50μA
Accuracy	±1°C
Temperature	-40°C ~ 125°C
Temperature measurement	Direct contact type
Measurement interval	1 sensor – 5seconds, 6 sensors – 30seconds
Transmission interval	50 seconds ~ 310 seconds
Wireless operating bandwidth	433Mhz (Zigbee)
Transmission power	10dBm
Transmission distance	≤500m (open air), 0.4~20m (enclose)
Protection level (IP)	IP4X
Flame retardant grade	V0 (700°C 30sec)
Withstand voltage	2.5kV
Impulse withstand voltage	Uimp = 8kV
Miscellaneous	
Cable sensor host dimension	50.2 x 66.2 x 25 (mm)
Cable length	50cm, 100cm
Weight	207gram
Operation Temperature	-40°C ~ 85°C
Relative Humidity (RH)	≤95%RH (non-condensing)
Storage Temperature	-10°C ~ 75°C
Mounting method	Magnetic, rail, binding
Certification 2014/35/EU LOW VOLTAGE DIRECTIVE; 2014/30/EU ELECTROMAGNETIC COMPABILITY DIRECTIVE	CE – EN 61000-6-2:2005+AC; EN 61000-6-4:2007+A1:2011; EN 62366-1:2014+A11:2017

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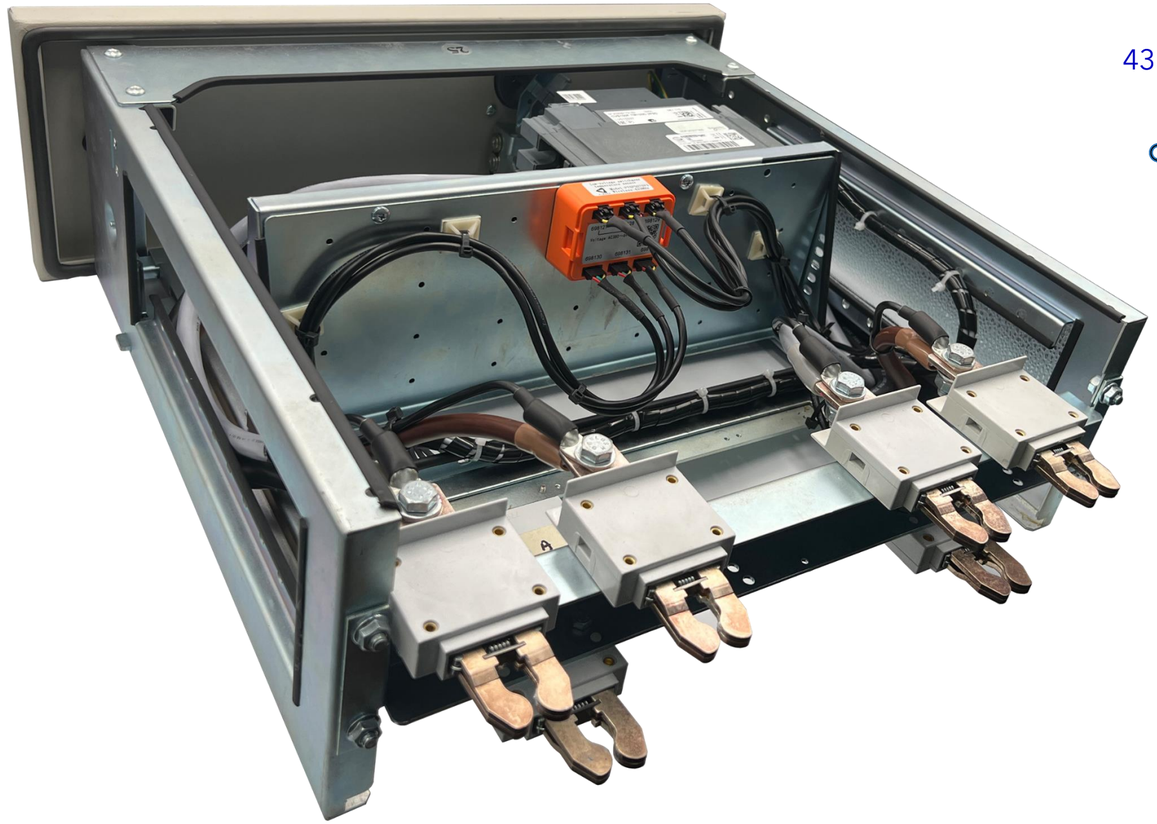
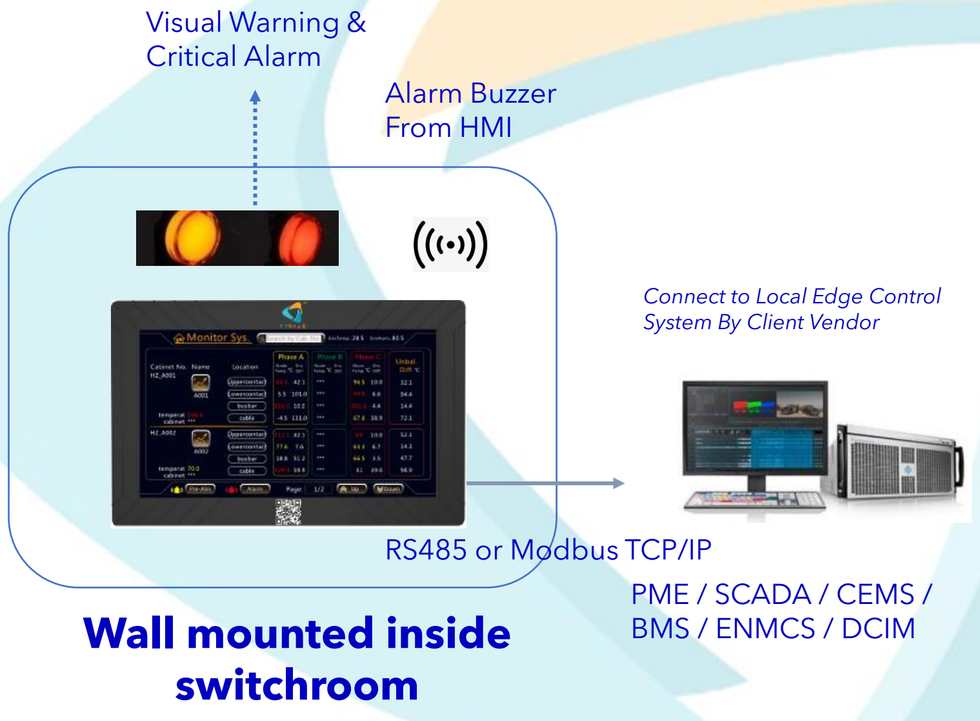
CADS – MCC Drawer



433Mhz



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PTSPD200F HMI Receiving Module

Product Overview

The PTSenR HMI Receiving Module (PTSPW2000F) device is an ideal for company to wish to continuously thermally monitoring for electric power, electrical equipment connection point site due to material aging, poor contact, current overload, and other factors caused by excessive temperature rise there is a hidden problem, cannot monitor the electrical equipment internally. The PTSPW2000F design adopts ultra-low power Zigbee Green Protocol design, RF wireless isolation, photoelectric isolation technology, with complete isolation, strong anti-jamming ability, reliable operation, easy installation and so on, very good solution to the high voltage state of various data monitoring problems.

Specification

Power Supply Input Voltage	AC85 ~ 264V DC110V / 220V
Maximum Power Consumption	≤5W
Wireless Operating Bandwidth	433MHz /2.4Ghz (Zigbee)
Wireless Reception Sensitivity	-110dBm
Wireless Receiving Distance	0.4 ~ 300meter
Communication Output	RS485, Ethernet, GPRS
Alarm of outputs	Built-in buzzer, relay output, temperature value font colour changes
Output relay	1 Passive Relay (Dry Contact)
Communication Rate	2400 ~ 115200 bps **(Default 9600bps)**
Communication Protocol	Standard Modbus-RTU protocol
Max numbers of sensors	1,000 Temperature, 100 Humidity

Graphic Display Screen

Graphic Display Screen LCD Type	WQVGA Colour TFT, LCD display
Viewing area	7-inch / 10-inch
Illumination backlight	White LED, software-controlled
Colours	65,536 (16bits)
Touchscreen	Resistive, analog
Virtual Keypad	Display virtual keyboard when the application requires data entry

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PTSPD200F HMI Receiving Module

The PTSPW2000F HMI provide complete integral monitoring solutions for a variety of high and low voltage switch cabinet contacts and contacts, gate switches, high-voltage cable middle head, dry transformers, low-voltage high-current cabinet and other electrical equipment online monitoring. Is suitable for both new build and retro-fit.

A simple to use, using the pre-configured screens, provides an easy-to-use graphical interface to indicates the status of all sensors, as well providing a set relay contact and two RS485 points, allow for connection to a BMS or SCADA systems.

Miscellaneous

Battery Back-up	Via Super-Cap and RTC and system data
Dimensions Size	7-inch: 210 x 140 x 49 (mm) 10-inch: 267 x 170 x 56 mm)
Mounting cut-out	7-inch: 201 x 131 x 45 (mm) 10-inch: 201 x 131 x 45 (mm)
Weight	7-inch: 0.62 (kgs) / 10-inch: 0.9 (kgs)
Operation Temperature	-20°C ~ 70°C
Relative Humidity (RH)	≤95%RH (non-condensing)
Storage Temperature	-20°C ~ 85°C
Mounting method	Rail, Embedded, Wall-Mounted
Certification 2014/35/EU LOW VOLTAGE DIRECTIVE; 2014/30/EU ELECTROMAGNETIC COMPABILITY DIRECTIVE	CE – EN 61000-6-2:2005+AC; EN 61000-6-4:2007+A1:2011; EN 62368-1:2014+A11:2017

Ordering Information

Part Number	Product Description
PTSPW2000F	PTSenR HMI Receiving Module

System Architecture

Control Room

BMS/SCADA/DCIM

RS485/Optic fiber/LAN/RF

Wireless data receive terminal

Wireless
temperature sensor

433MHz

433MHz

Wireless
temperature sensor

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Standalone Server W/ HMI Receiving Module

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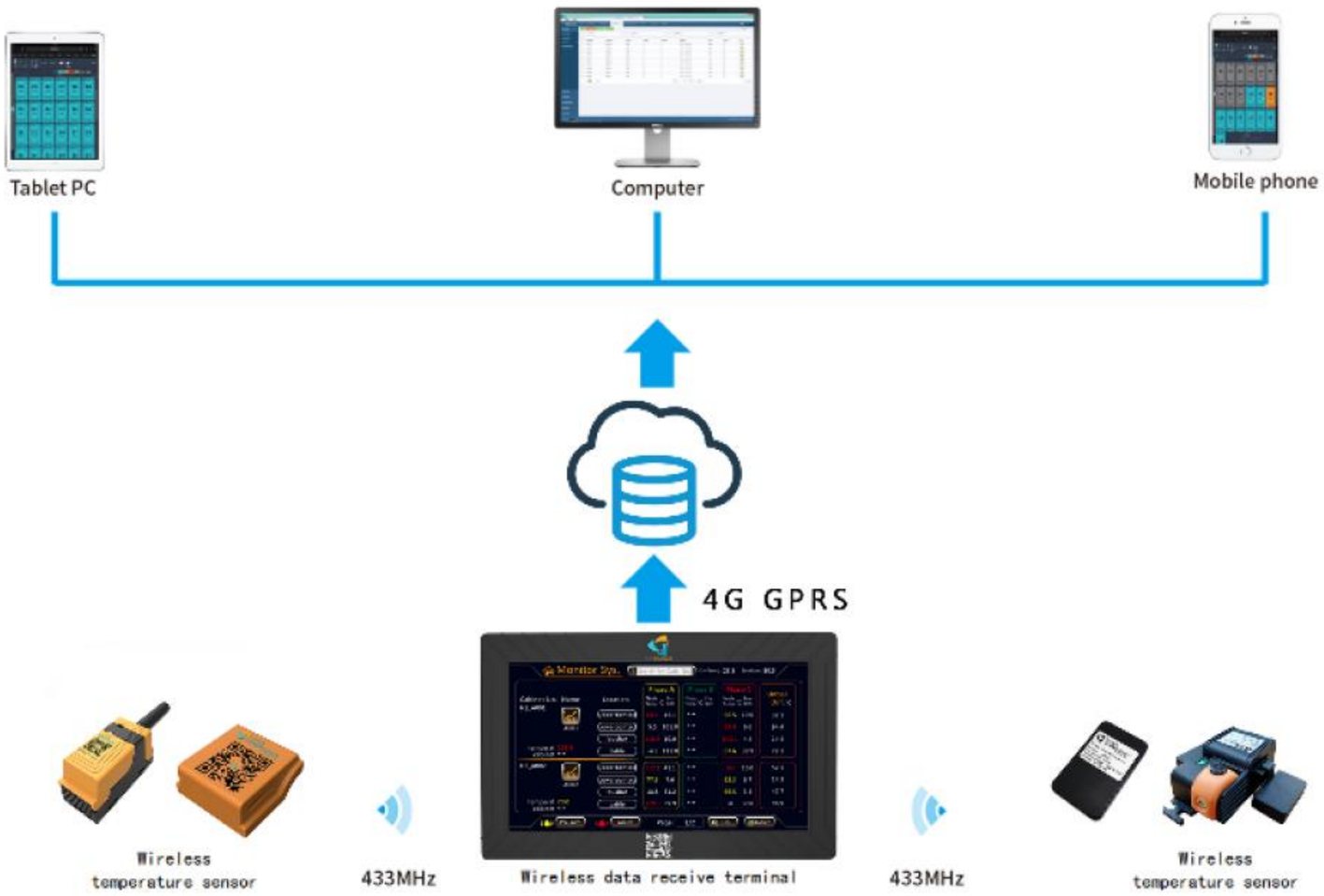
CLOUD storage with remote monitoring



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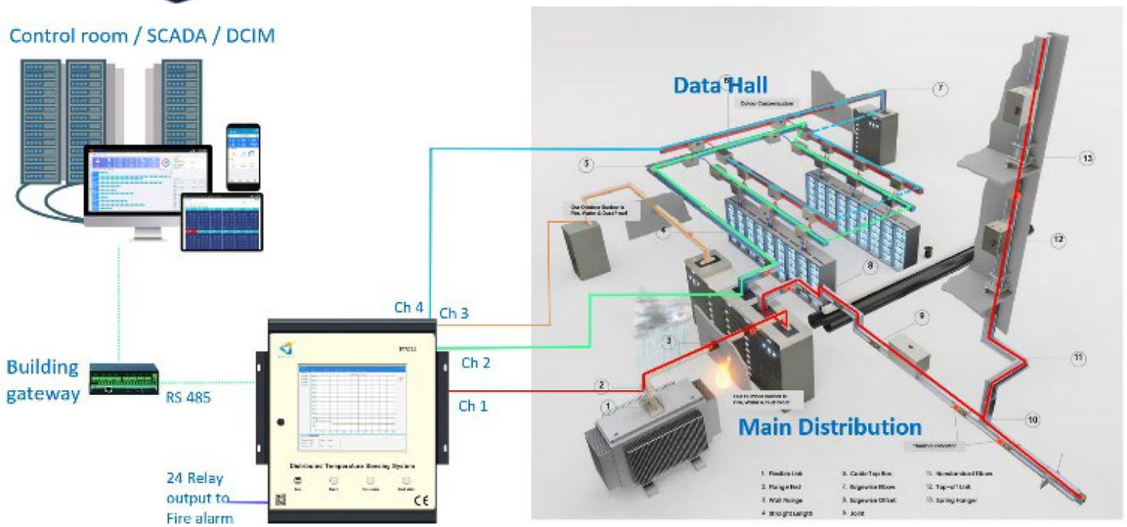
PTSGL1 Distributed Temperature Sensing (DTS) System



Specification

Power Supply Input Voltage	24VDC
Number of Channel	4
Operating Temperature Setting	-40ºC ~ 120ºC (Default Alarm 85ºC)
Temperature Accuracy	±1.0ºC
Temperature Resolution	±0.1ºC
Test Frequency	2s / Channel
Measuring Distance Per Channel	2.5km / channel
Over Current Power Protection	8A
Relative Humidity (RH)	≤95%RH (non-condensing)
Working Temperature	-10ºC ~ 50ºC
Storage Temperature	-20ºC ~ 65ºC
Temperature measuring range	-40 ~ 125ºC
Number of Relays	24
Communication Ports	USB / RS 232 / RS 485
Alarm Mode	Rate of rise and fixed temperature
Detection Method	Distributed
Restore Performance	Recoverable
Functional Composition	Detection & Alarm Type
Standard Alarm Length	3meter
Fiber Optic Connectors	FC / APC standards Fiber
Fiber Optic Cable	IP 67 & EX II C TG Gb
Laser	Class 1
Certification	EN 55014-1:2006/A2:2011; EN 55014-2:1997/A2:2008; EN 60335-1:2012/A11:2014; IEC 60815-1:2014; GB 16280-2014; GB 25286.1-2010

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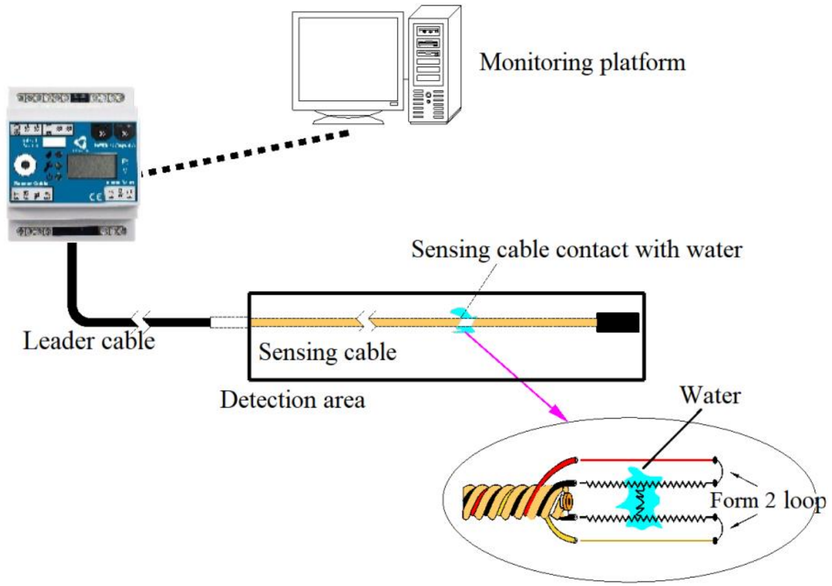
PTSPCM-3A Water Leak Detection System



Product Overview

PTSenR PTSPCM-3A locating liquid leak detector relay with LCD and can detect the area up to 150 meters, monitoring of environmental leakage, once the liquid is detected, the sensor immediately alarms and accurately locate the leakage position and trigger the relay. The specific location of leakage can be read through the LCD display screen. The relay contact signal and 485 signal output by the detector can be integrated with various monitoring systems to realize remote monitoring.

Specification

Power Supply Input Voltage	12VDC
Maximum Power Consumption	≤0.5W
Sensing Performance	Detection distance: 150m
	Response time: ≤8s
	Detection accuracy: ±0.5m + 1%
	Reading accuracy 0.1m
Communication Protocol	Modbus-RTU, Modbus-ASC II self-adaption
Communication Rate	1,200bps, 2,480bps, 9,600bps (default), 19,200bps
Relay Output	Dry Contact, 1 set NC/NO
Miscellaneous	
Dimensions Size	70 x 86 x 57.6 (mm)
Weight	281.19gram
Operation Temperature	-20°C ~ 70°C
Relative Humidity (RH)	≤95%RH (non-condensing)
Storage Temperature	-10°C ~ 75°C
Mounting method	Standard 35mm guide rails
Certification	CE - EN 55032: 2015, EN 55035: 2017 ROHS – 2011/65/EU, IEC 62321:2013

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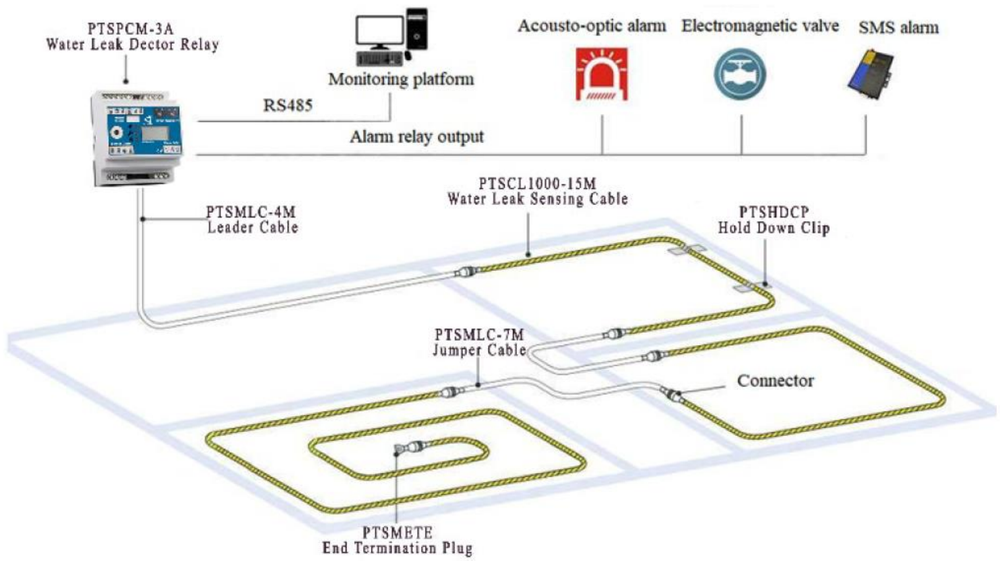
PTSPCM-3A Water Leak Detection System

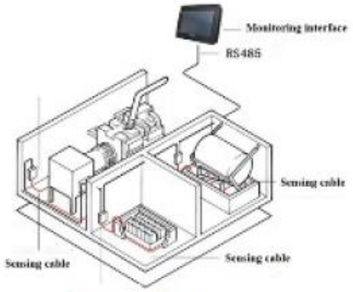
The System Architecture



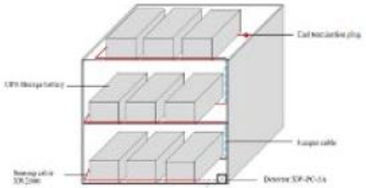
Leakage Controller

Water Sensing Cable

Oil Sensing Cable

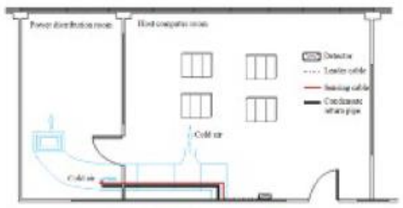


Generator Room



Battery Storage

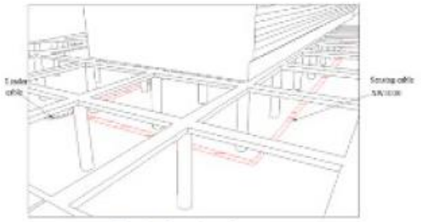
Lift Shaft Room



Chiller Plant Room

Piping

Toilet



Data Center Crac

Pump Room

Warehouse

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PTSPS104 Temperature Vibration Sensor System

Product Overview

PTSenR PTSPS104 have ability to comprehensively monitor temperature & vibration data, such as transformer and motor. The growing factory automation leads to wide application of electronic and automatic equipment. With more and more transformers and electric motors are used. Long-term operation of transformers and electric motors results in greater vibration over time, which will trigger irrecoverable faults if not handled in time.

Specification

Power supply input	DC 3.6 battery powered
Energy Harvesting	<50μA
Temperature measurement	-40°C ~ 150°C
Frequency	10 ~1Kz
Transmission interval	One detection / 1 minutes (customizable), instant if vibration amplitude >0.5mm/s, 15minutes if no vibration occurs
Wireless operating bandwidth	LORA
Speed scope	0 ~50mm/s
Transmission distance	≤300m (open air)
Monitoring direction	In three axis (X,Y,Z)
Battery life	2 ~3 years
Explosion-proof level	ExiaIICT4Ga (application to zone 0,1,2)
Miscellaneous	
Cable sensor host dimension	39 x 85 mm (cylinder diameter x height)
Weight	250gram
Operation Temperature	-30°C ~ 80°C
Relative Humidity (RH)	≤90%RH (non-condensing)
Storage Temperature	-10°C ~ 75°C
Mounting method	Magnetic or bolt
Certification 2014/35/EU LOW VOLTAGE DIRECTIVE; 2014/30/EU ELECTROMAGNETIC COMPABILITY DIRECTIVE	CE – EN 61000-6-2:2005+AC; EN 61000-6-4:2007+A1:2011; EN 62366-1:2014+A11:2017

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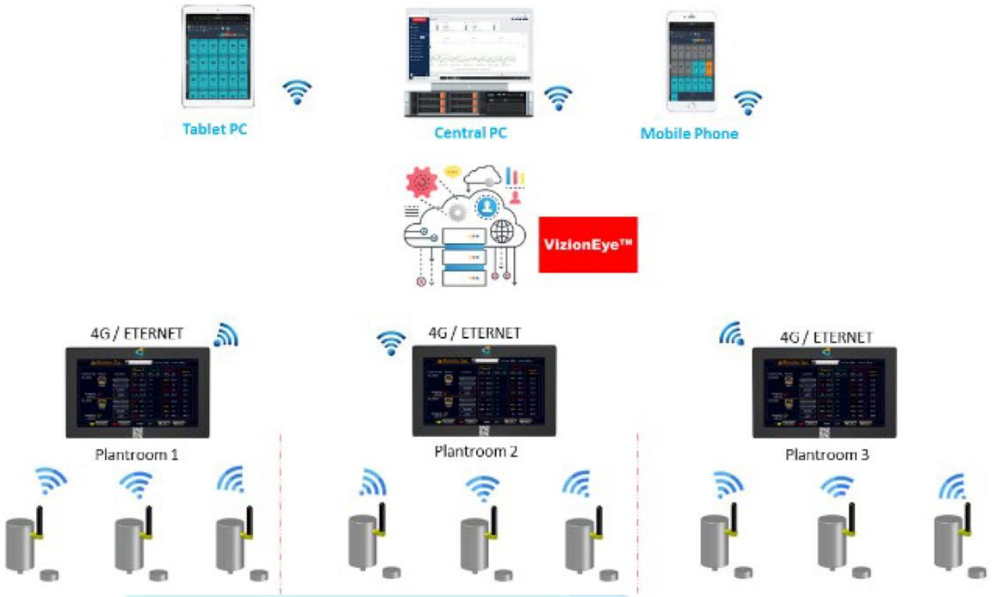
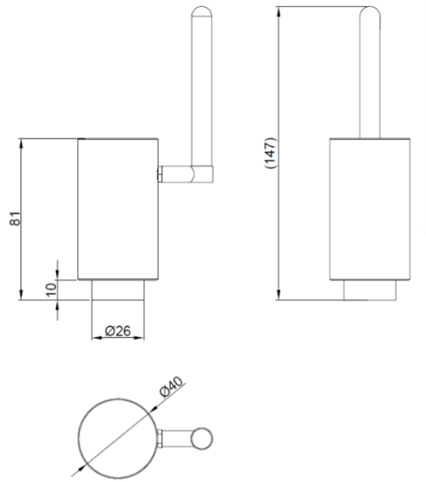
PTSPS104 Temperature Vibration Sensor System



Features

- Wireless data transmission
- No messy wiring
- No external power
- Continuous 24 x 7 temperature & vibration monitoring
- Accurate
- Fast + easy installation
- No require for human intervention & inspection
- Strong anti-interference
- Detects faults before fail
- Easy integration

Dimensions (Unit: mm, tolerance: ±1%)



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- **System Architecture**

Total Solution : Power Online Continuous Asset Diagnosis Monitoring System

PT Vizioneye

Client Local HMI / DCIM / EPMS

Open Protocol

PTService

Cloud Data Center

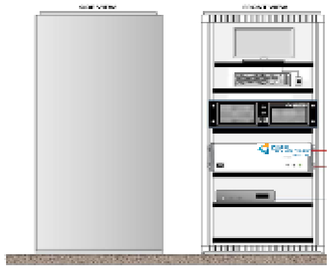
Partial Discharge Monitoring

Intelligent DAU

PD & Temperature Sensor

Oil Immersed TR

GIS



DTS

Intelligent DAU

DTS Power Cable

Power Cable

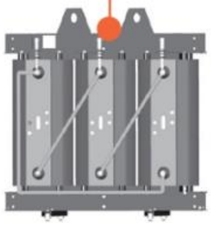
Temperature Monitoring

Intelligent DAU

EH Temperature & Humidity

Switchgear Panel

PD & Temperature Sensor



Dry Type Tx

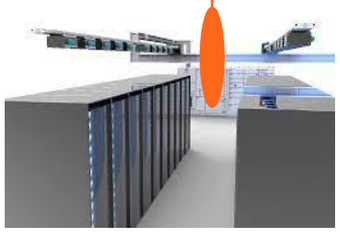
Vibration & Temperature

Rotating Machine

DTS

Intelligent DAU

DTS Busduct



Busduct

System Architecture (Considerations)

3rd Party Solutions

Humidity Sensor

Temperature Sensor

Temperature Sensor

Temperature Sensor

Temperature Sensor

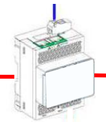
Oil Transformer 2500kVA

Oil Transformer 2500kVA

Oil Transformer 2500kVA

Oil Transformer 2500kVA

Wireless Access Point



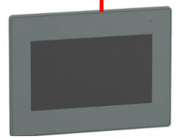
Ethernet Gateway

Wireless Gateway

Router

Antenna

Digital Service Cloud Analytics



HMI

Powertechnologies Solutions

Temperature Humidity Sensor

Temperature Sensor

Temperature Sensor

Temperature Sensor

Temperature Sensor

Oil Transformer 2500kVA

Oil Transformer 2500kVA

Oil Transformer 2500kVA

Oil Transformer 2500kVA

Receiving HMI
+
Ethernet Gateway
+
Wireless AccessPoint

Wireless Gateway

Router

Antenna

Digital Service Cloud Analytics

Local Analytics

PME / SCADA / CEMS / BMS / ENMCS / DCIM

Connect to Local Edge Control System By Client Vendor

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System Architecture (Considerations)

Key Factors	Common Wireless Sensors	Power Technologies PTSenR PTS061	Wireless Sensor Consideration Factors
Voltage Withstand Limits	52KV	500KV	Ensure Sensors comes with Higher Voltage Withstand Capabilities “Durability Factor”
Current Withstand Limits	5000A	6000A	Ensure Sensors comes with Higher Voltage Withstand Capabilities “Durability Factor”
Size	31mm x 31mm x 14mm	23mm x 23mm x 10mm	Reduced Dimension Sensors will have facilitate installation “Installation Factor”
Wireless Transmission Power	5dBM	10dBM	Stronger Transmission Power will enable greater transmission Distance “Wireless Transmission Factor”
IP Protection	IP 54	IP 68	Higher IP Rating will expand the range of installation coverage possibilities “Weather Proof Factor”
Temperature Measurement Range	-25 to 115 Celcius	-45 to 125 Celcius	Higher Temperature will expand the range of installation coverage possibilities “Weather Proof Factor”
Accuracy	+/- 1 Celsius between -25 to 80 Celsius +/-2 Celsius outside of range	+/- 1 Celsius for all range	“Measurement Accuracy Factor”
Max. Transmission Distance from Sensor to Access point	100m with open line of sight 1 to 3 meter in metal Enclosure	500m with open line of sight 5 to 20 meter in metal Enclosure	Longer Transmission Power will enable lesser signal repeater required “Wireless Transmission Factor”

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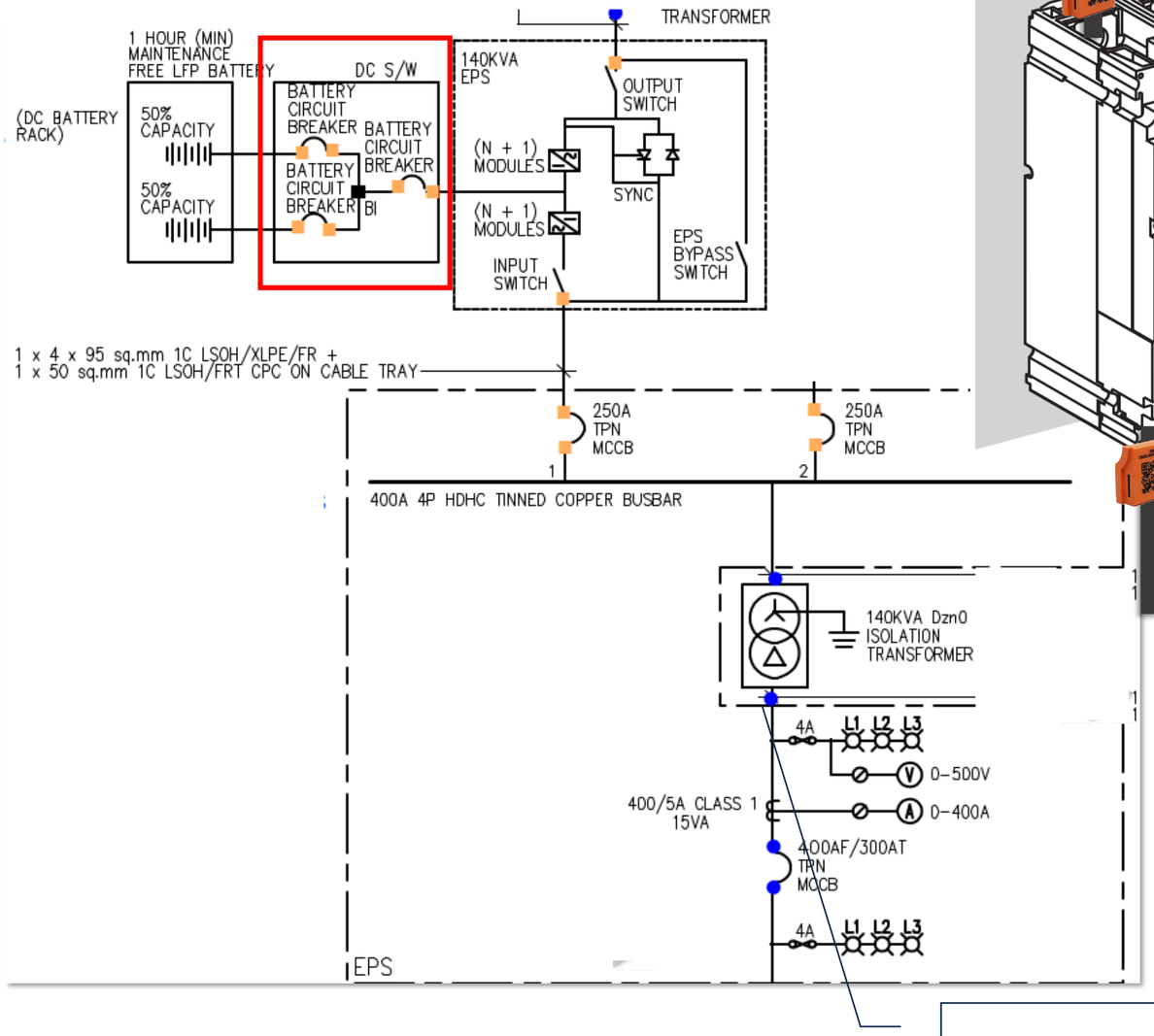
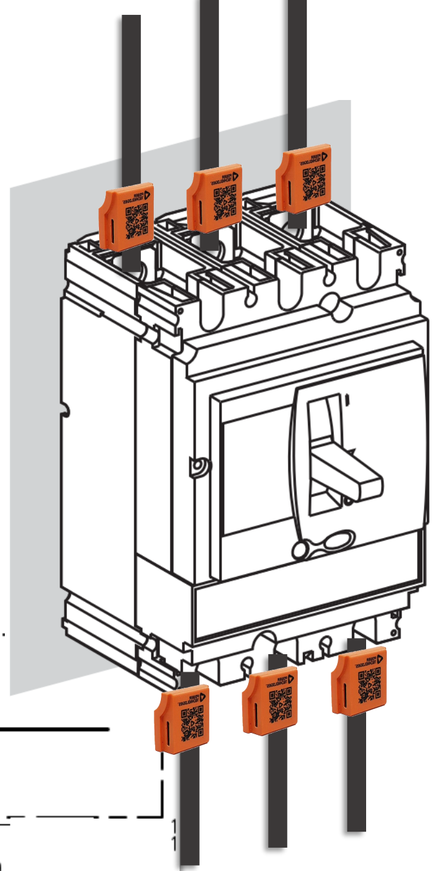
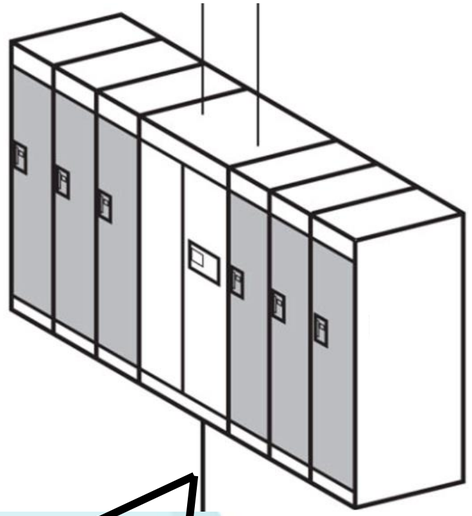
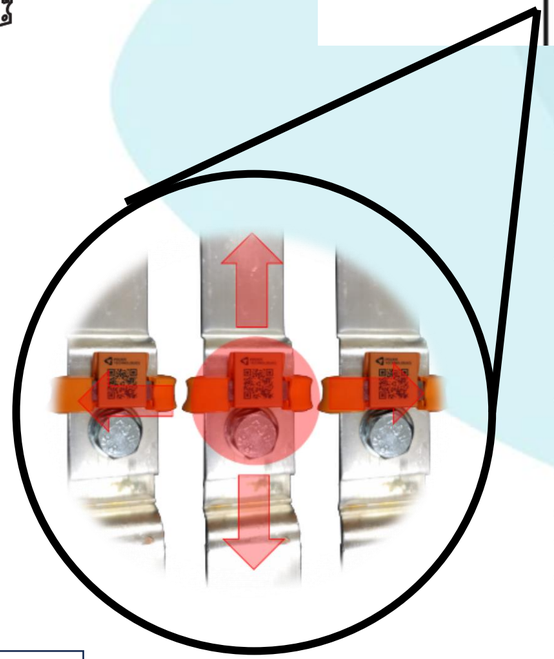
- **Applications in DataCenters**

UPS Applications









- **Strap-To-Cable**
  Easy Installation
- **Non-Contact**
- **Delta-T**
  - Using NETA Maintenance as a standard for an early detection of compromised joint
- **Non-Powered**
  - There is no amplifier build in the sensor. It reduce annual calibration of the device.
- **LV Cable Connections**
- **Lifetime Calibration**

140KVA Isotran capable to deliver a Fault Current of 3,895Amps

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LV Switchgear

Workstation

Industrial Server

SCADA / BMS / EMPS

Open Protocol

Modbus TCP/IP / Modbus RTU

Building Gateway

Ethernet

CLOUD

01 PTSPS061

02 PTSPS061

03 PTSPS114

04 PTSPW200F

05 PTSPS075

Remote access via Embedded
Web based GUI

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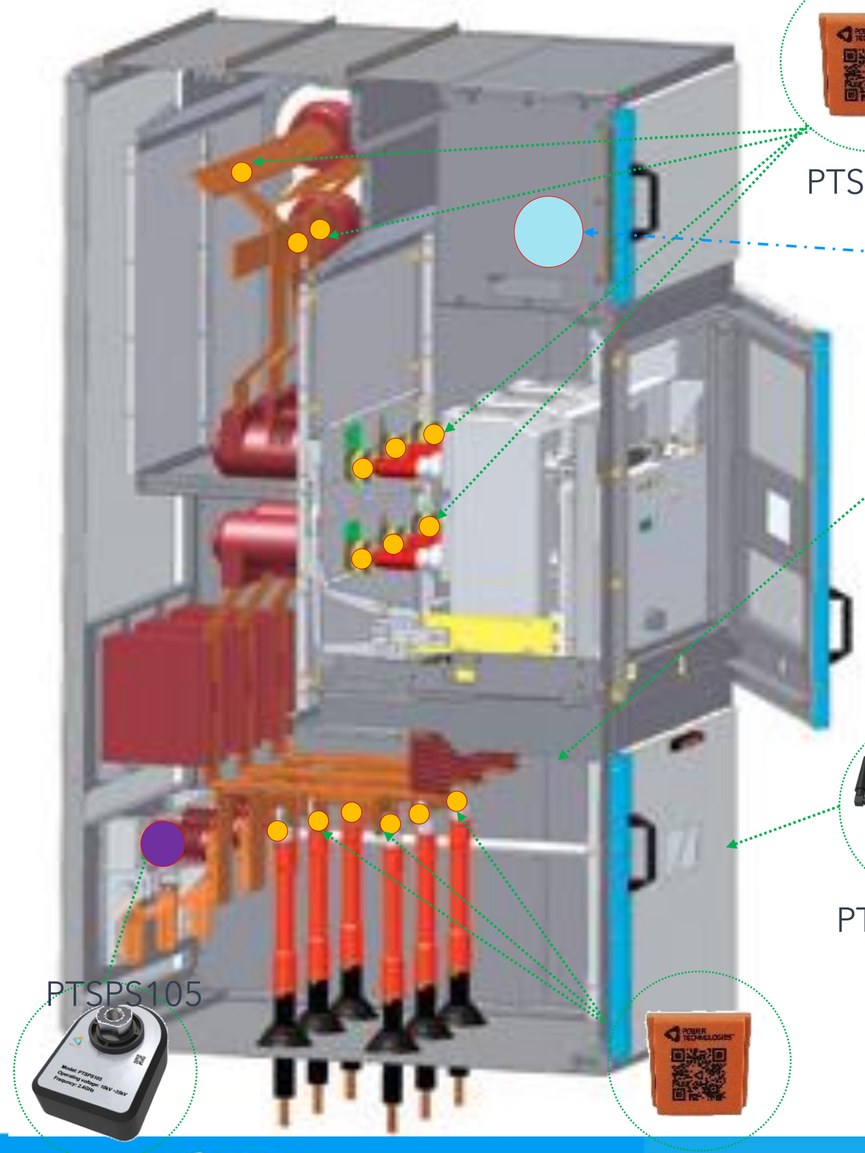
Switchgears



PTSPS061

PTSPS114

PTSPD4000W

PTSPS105

LV compartment / within switchroom

PTSPW2000F

PTSPS1807

PTSPS1810

RS485 / Modbus TCP/IP

Building gateway

Control room / SCADA / DCIM

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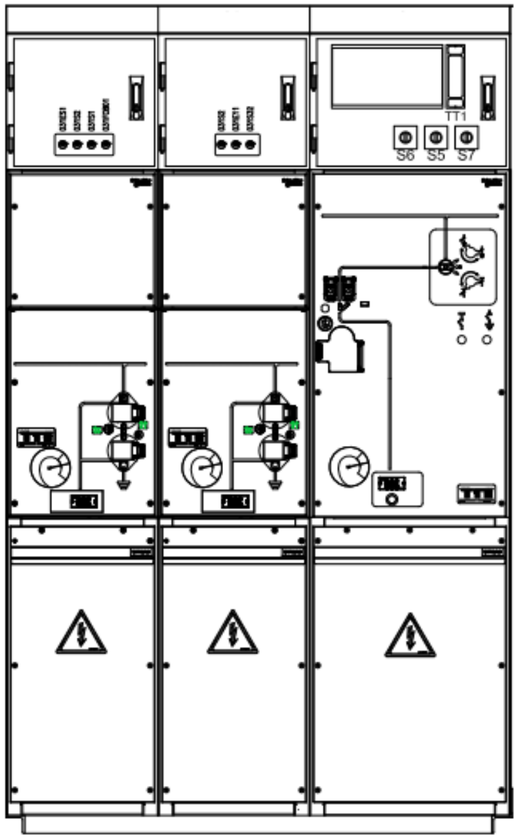
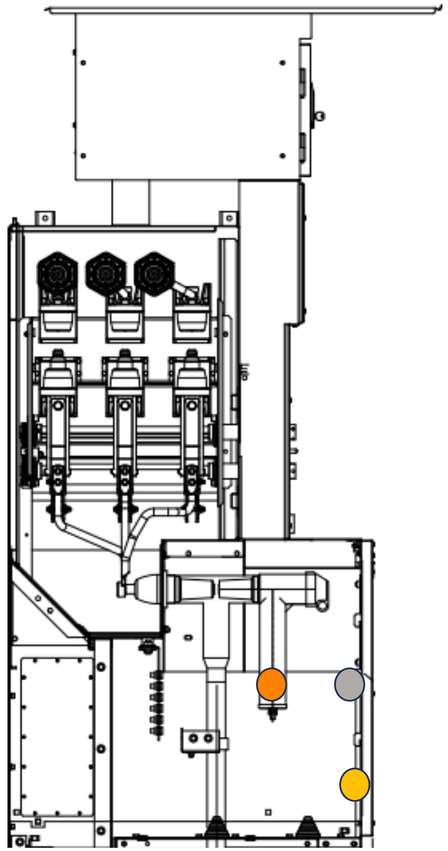
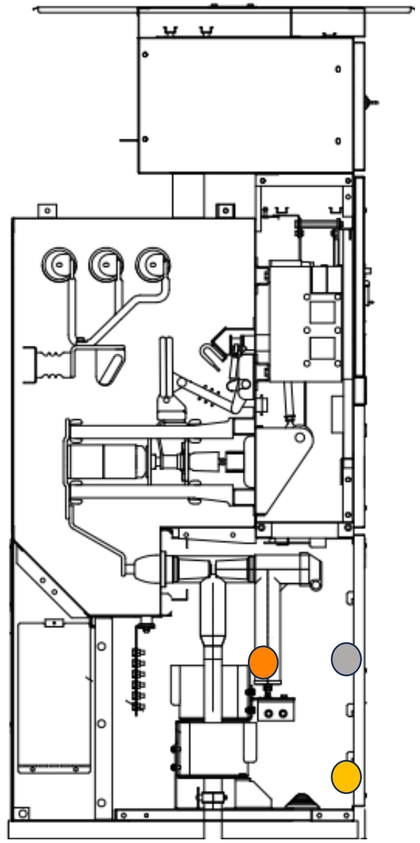
InFeeder1 InFeeder2 Transformer Feeder



InFeeder1/ InFeeder 2

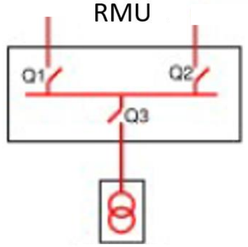


Transformer Feeder



Continuous Online Partial Discharge Monitoring

RMU



Self-Powered Wireless Temperature Sensors

Mounted on cable bushing, which allows Continuous realtime temperature monitoring

Wireless Humidity Sensor

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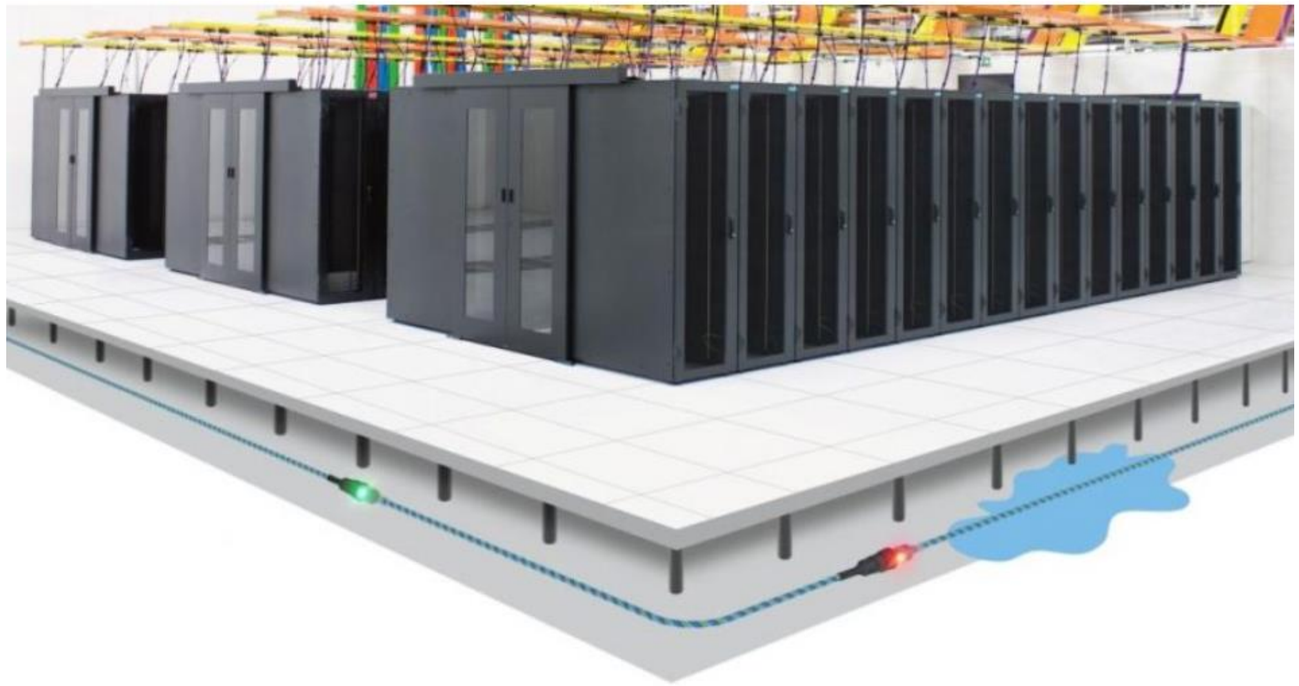
Leak Detections in DataHall



Locating Leak Controller

Model: PTSPCM-4

Size: 95mm*75mm*48.5mm

Support: DC9-30V

Output: RS485,Modbus; Relay (N.O/N.C)

Installation: 35mm standard DIN rail

Features:

1. Leak detection response time: 5-8s
2. Locating accuracy: ±0.5m+1%FS
3. Cable break, leak, interference alarm
4. Display screen indicates leak location

★ Detection distance 1500m;

★Rohs, CE

Water Sensing Cable

Model: PTSLC1000B

Size: Ø6mm

Standard Length: 7.5m, 15m, 30m

Installation: Match with locating controller

Features:

1. Uniform resistance, the error is within 1%
2. Location function
3. Quick drying
4. Unique waterproof structure of the plastic plug, can be extended cascade

★ High temperature resistance: work safe & effective under 100°C, maximum 120°C

★ Rohs

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Leak Detections in DataHall

Locating Leak Controller

Model: PTSPCM-4
Size: 95mm*75mm*48.5mm
Support: DC9-30V
Output: RS485,Modbus; Relay (N.O/N.C)
Installation: 35mm standard DIN rail

Features:
1. Leak detection response time: 5-8s
2. Locating accuracy: ±0.5m+1%FS
3. Cable break, leak, interference alarm
4. Display screen indicates leak location

★ Detection distance 1500m;
★Rohs, CE

Water Sensing Cable

Model: PTSLC1000B
Size: Ø6mm
Standard Length: 7.5m, 15m, 30m
Installation: Match with locating controller
Features:
1. Uniform resistance, the error is within 1%
2. Location function
3. Quick drying
4. Unique waterproof structure of the plastic plug, can be extended cascade

★ High temperature resistance: work safe & effective under 100°C, maximum 120°C
★ Rohs

Jumper cable

Model: PTSMLC-7M
Size: Cable Ø4.5mm; Connector Ø24mm
Standard Length: 7m
Installation: For connection of two sensing cables

Oil Sensing Cable

Model: PTSLC3000D
Size: Ø6mm
Standard Length: 7.5m, 15m, 30m
Installation: Match with locating controller
Features:
1. Uniform resistance, the error is within 1%
2. Location function
3. Quick drying
4. Unique waterproof structure of the plastic plug, can be extended cascade

★ Not react with water, disposable product
★ Rohs

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- **Project References**

Total Sensor Operation World Wide

Till 2024 January

Running in 1,650

More than 690,000 pcs

Facilities Infrastructure

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Project Realization

Indonesia Hydro Power Plant, Indonesia

What we did?

- ✓ PTSPS061 Temperature
- ✓ PTSPD4000W 5in1 Partial Discharger Sensor
- ✓ PTSPS102
- ✓ Digitalize the asset
- ✓ 100% uptime
- ✓ Optimise Operation

Application

- ✓ 36kV switchgear
- ✓ VCB Tulip Connection
- ✓ Shipping Splits termination
- ✓ Cable Termination

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Project Realization – PTSPS067 Infrared Sensor

Features

i. IP50
ii. V0 700˚C for 30 seconds
iii. Easy integration
iv. Lifetime calibrated
v. Fast + easy installation
vi. Detects faults before fail
vii. Energy Harvesting / Powered
viii. Continuous 24x 7 temperature monitoring
ix. Installed INSIDE electrical switchboards
x. Wide monitoring area FOV 90 ° x 90° (1024 monitoring point)

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Project Realization – PTSPEC6 Temp & Dehumidifier

PTSPEC6 Temperature & Dehumidifier

- ✓ Intelligent control temperature & humidity in LV panel
- ✓ Low- energy consumption
- ✓ Adopts semiconductor refrigeration to dehumidify
- ✓ Easy to install

Features

i. Wireless data transmission;
ii. Eliminate manual inspection;
iii. Strong anti-interference;
iv. Automated control;
v. Effective control the condensation issue;
vi. Prevent fire or arc flash.

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Project Realization – PTSPEC6 Temp & Dehumidifier

Problem

- Low-Voltage Switchboard
- Water condensation inside Low-Voltage Switchboard
- Few explosion
- Hot-spot issue

What we did?

- ✓ Monitor & display temperature on the CB & MCC
- ✓ Monitor cubicle & room temperature & humidity
- ✓ Dehumidifier the water condensation issue

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Project Realization – PTSPS119 pC PD Sensor

PTSPS119 Pulse Current PD Monitoring

- ✓ Intelligent pC monitoring set IEC special test standard
- ✓ IP6X
- ✓ V0 700°C for 30seconds
- ✓ Advanced software and hardware combined noise cancellation and anti-interference technology.

Features

Sensitive monitoring;

- ➢ Easy to install;
- ➢ Small in volume
- ➢ No Drilling & Cutting
- ➢ Real-time monitoring of wireless communication;
- ➢ No additional power supply is required;
- ➢ Ring Main Unit, MV Switchgear,

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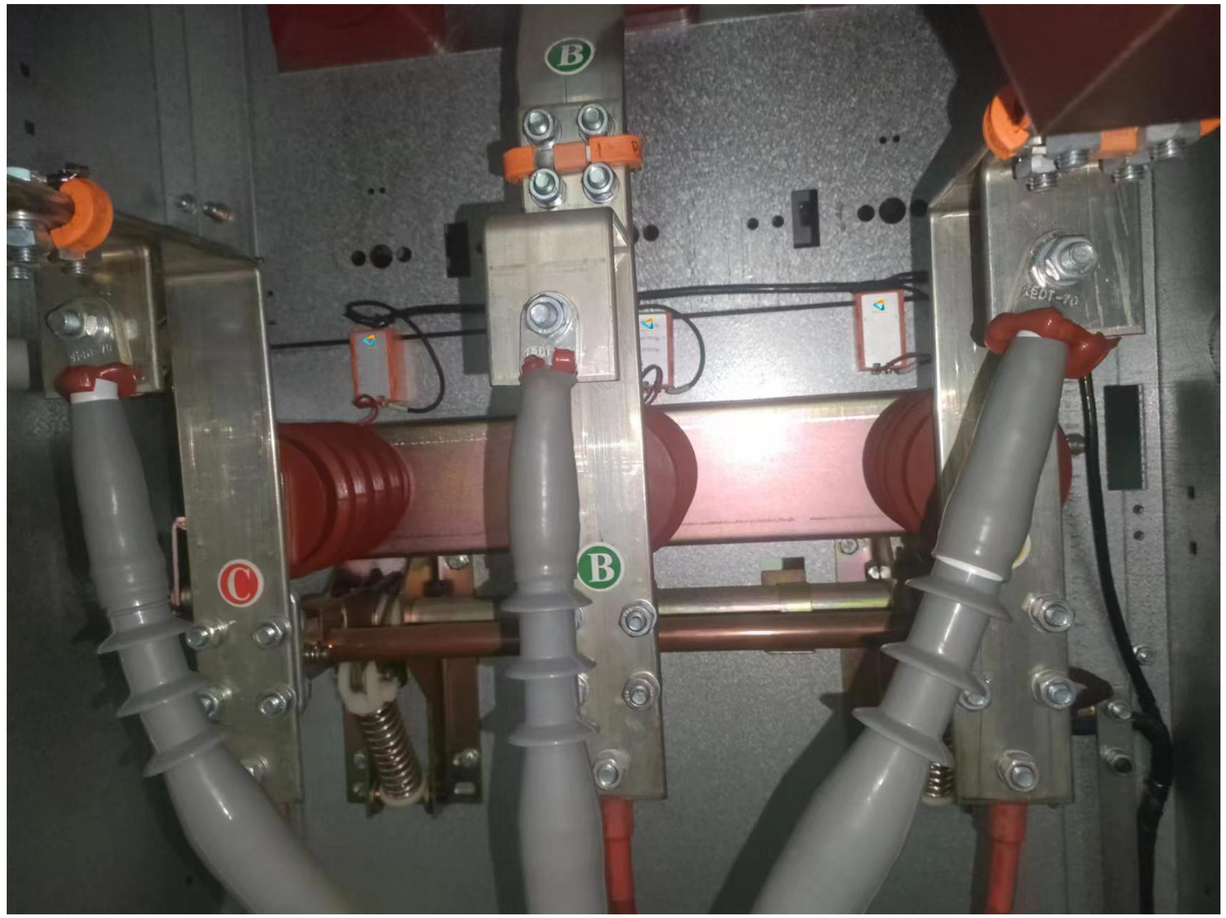
Project Realization – PTSPS119 pC PD Sensor



Problem

- Medium-Voltage Switchgear
- Partial Discharge
- Hot-spot issue

What we did?

- ✓ Monitor & display PD & temperature
- ✓ Monitor cubicle & room temperature & humidity

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Project Realization – PTSPD1000 nuclear Phase Pulse PD Sensor

PTSPD1000 Nuclear phase Pulse PD Sensor

- ✓ Intelligent pC monitoring set IEC special test standard
- ✓ IP4X
- ✓ V0 700˚C for 30seconds
- ✓ Advanced software and hardware combined noise cancellation and anti-interference technology.

Features

- ➢ Sensitive monitoring;
- ➢ Easy to install even LIVE panel
- ➢ No drilling or cutting
- ➢ Small in volume
- ➢ Connection mode of plug-in wire is convenient for on-site implementation
- ➢ Real-time monitoring of wireless communication;
- ➢ 3.6VDC battery operated;
- ➢ Three-phase partial discharge for simultaneous monitoring;
- ➢ Ring Main Unit, MV Switchgear.

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Project Realization – PTSPD1000 pC PD Sensor

Problem

- Mining Roller Belt
- Belt Wear &Tear
- Fire incident
- Roller bearing wear & tear
- Hot-spot issue at issue at bearing

What we did?

- ✓ Monitor & display temperature & RPM
- ✓ Predict & Alert end user before it fails

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Project Realization – PTSPSD3000 pC PD Sensor

PTSPS3000 Pulse Current PD Monitoring

- ✓ Intelligent pC monitoring set IEC special test standard
- ✓ In line with the IEC60270-2000
- ✓ Equivalent capacitor is used as a coupling capacitor for the partial discharge test of the pulsed current method
- ✓ IP54, V0 700˚C for 30seconds
- ✓ Advanced software and hardware combined noise cancellation and anti-interference technology.
- ✓ 5kV to 35kV

Features

- ➢ Sensitive & Accurate monitoring & display;
- ➢ Easy to install;
- ➢ Wireless communication;
- ➢ 220Vac power supply is required;
- ➢ strong anti-interference ability, adopts ultra-low power consumption
- ➢ LED shows whether the switch cabinet is live
- ➢ Maintenance-free,

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Project Realization – PTSPSD3000 pC PD Sensor

Problem

- Medium-Voltage Switchgear
- Partial Discharge
- Hot-spot issue

What we did?

- ✓ Monitor & display PD & temperature
- ✓ Monitor cubicle & room temperature & humidity

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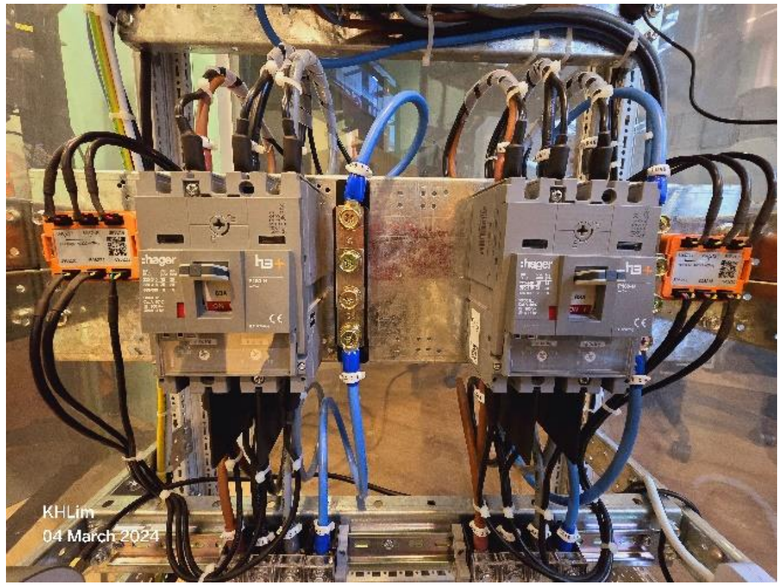
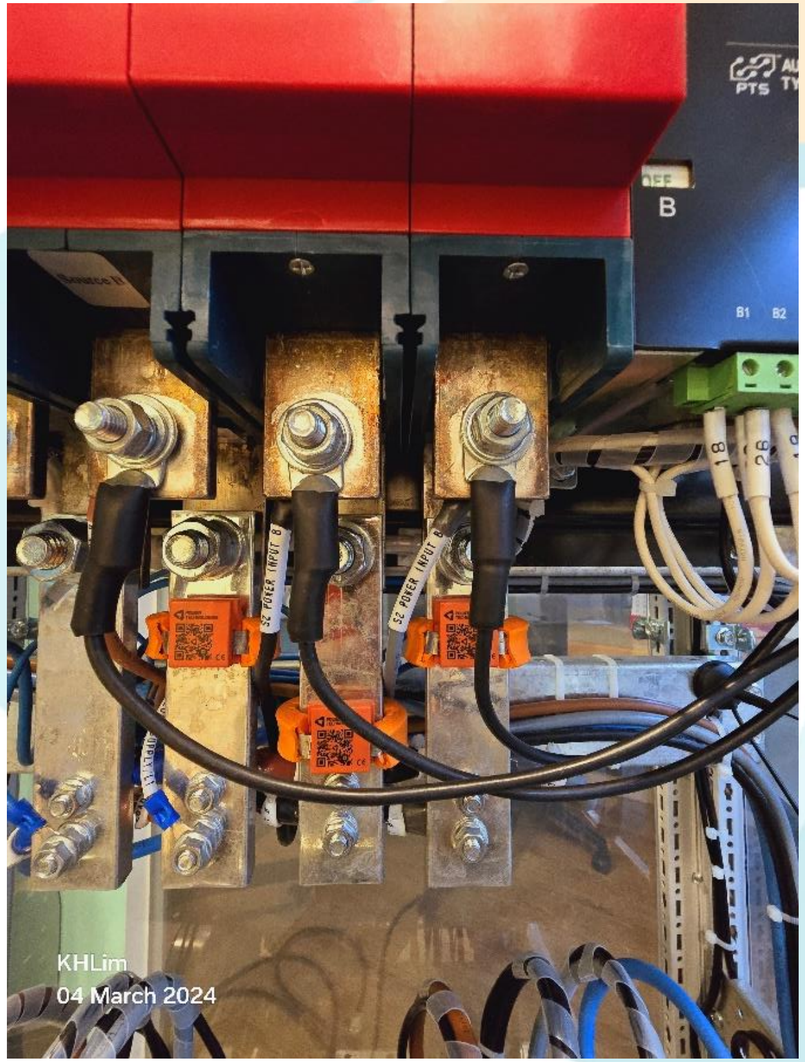
Project Realization





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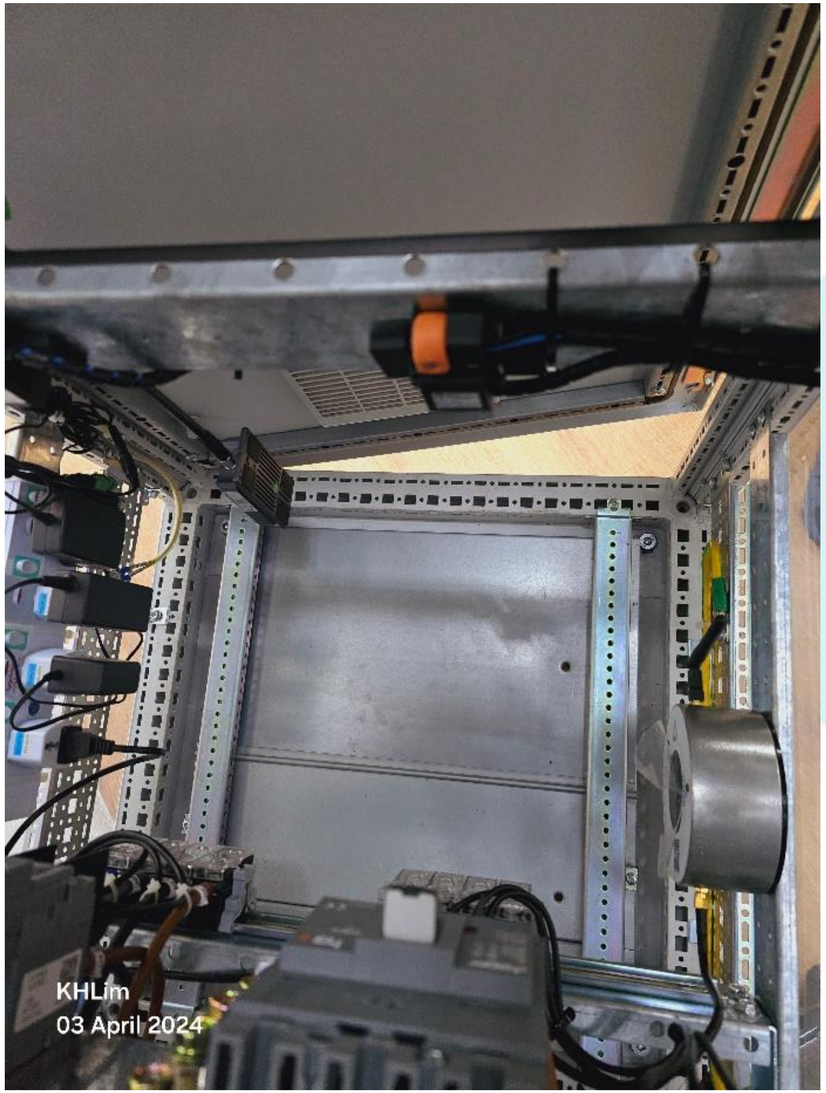

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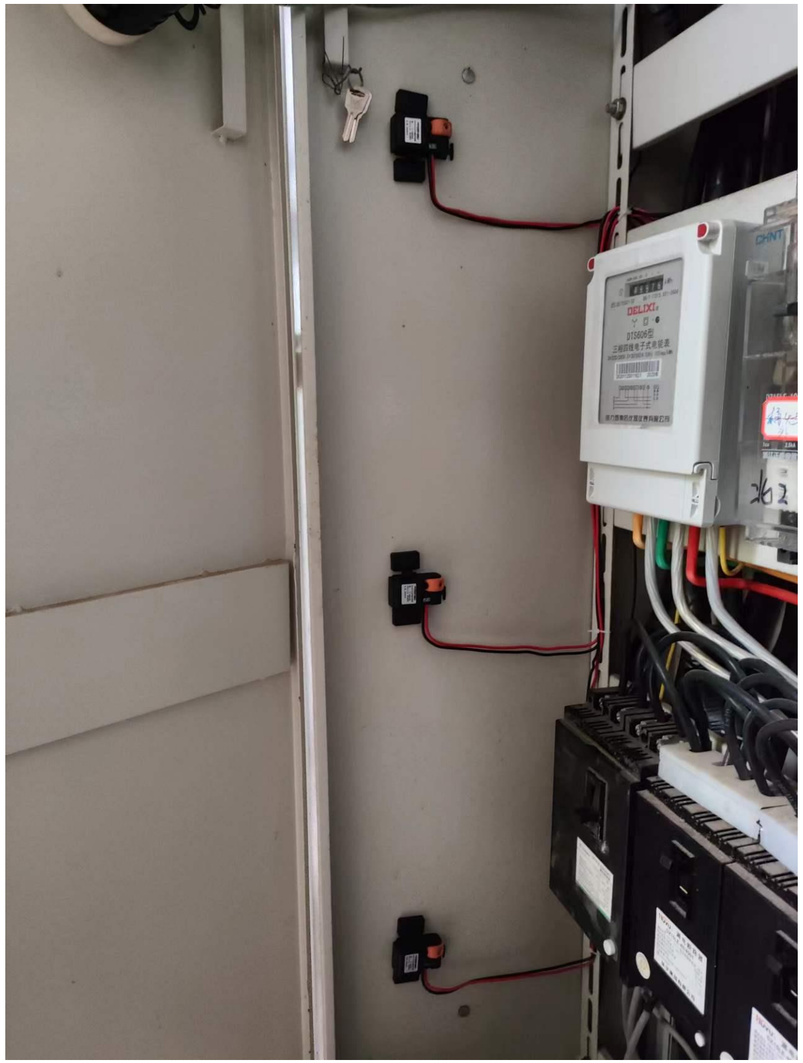

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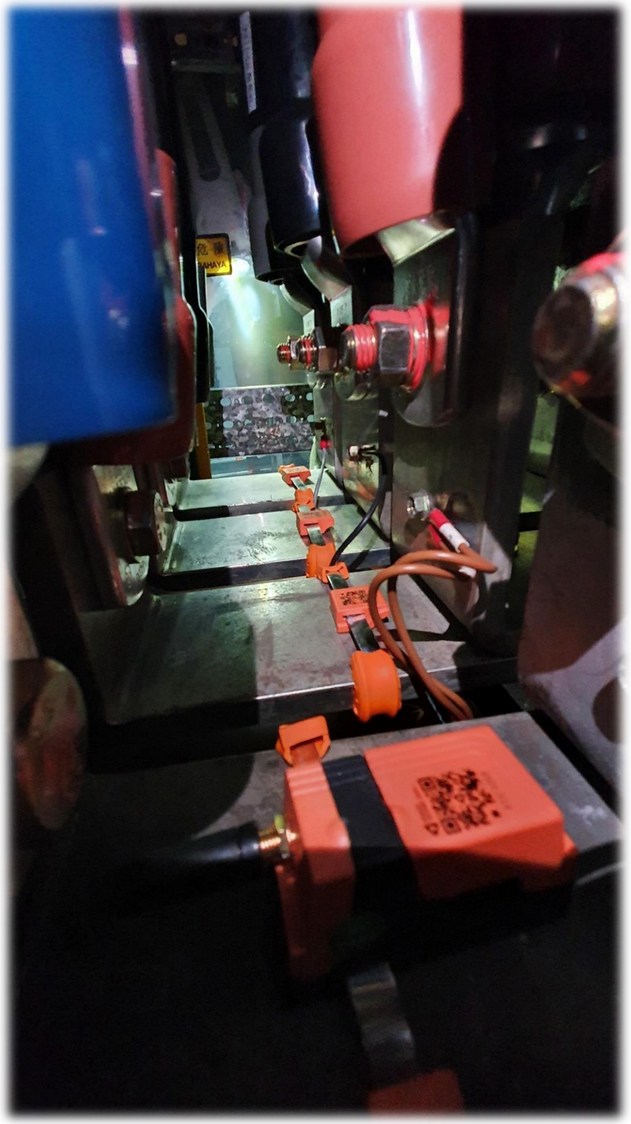

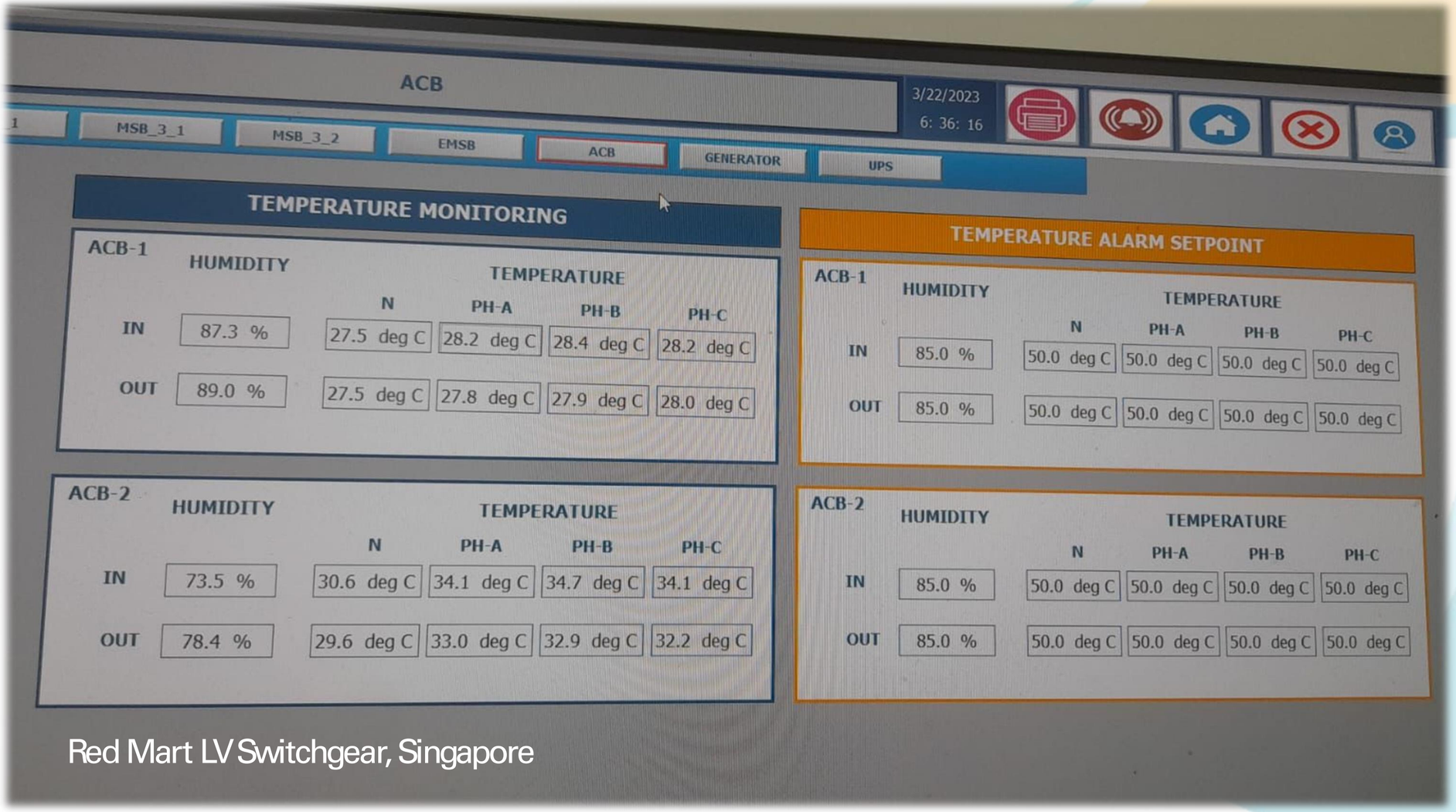

Red Mart LV Switchgear, Singapore

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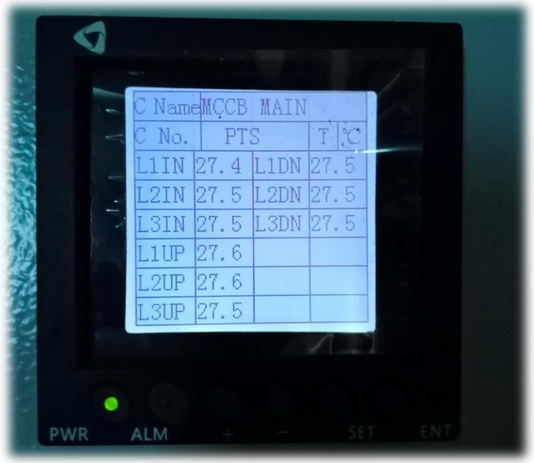
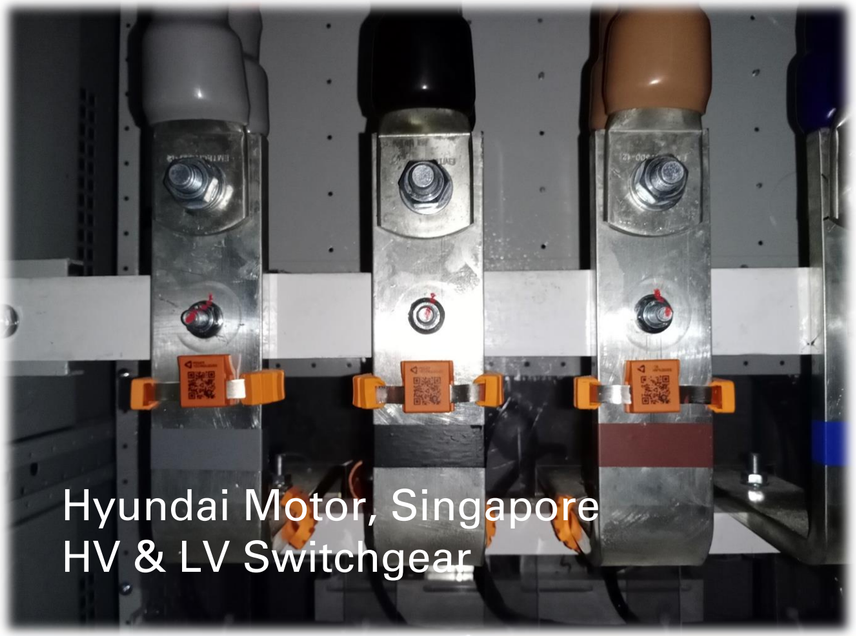
Project Realization

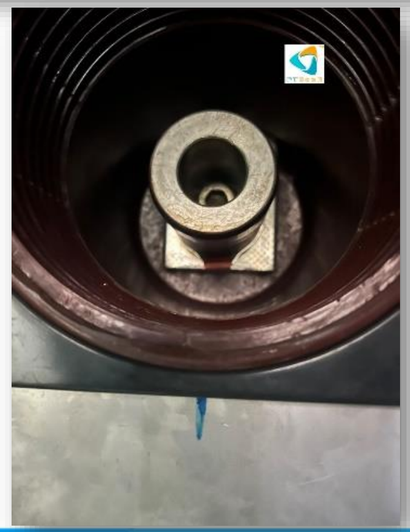
Project Realization

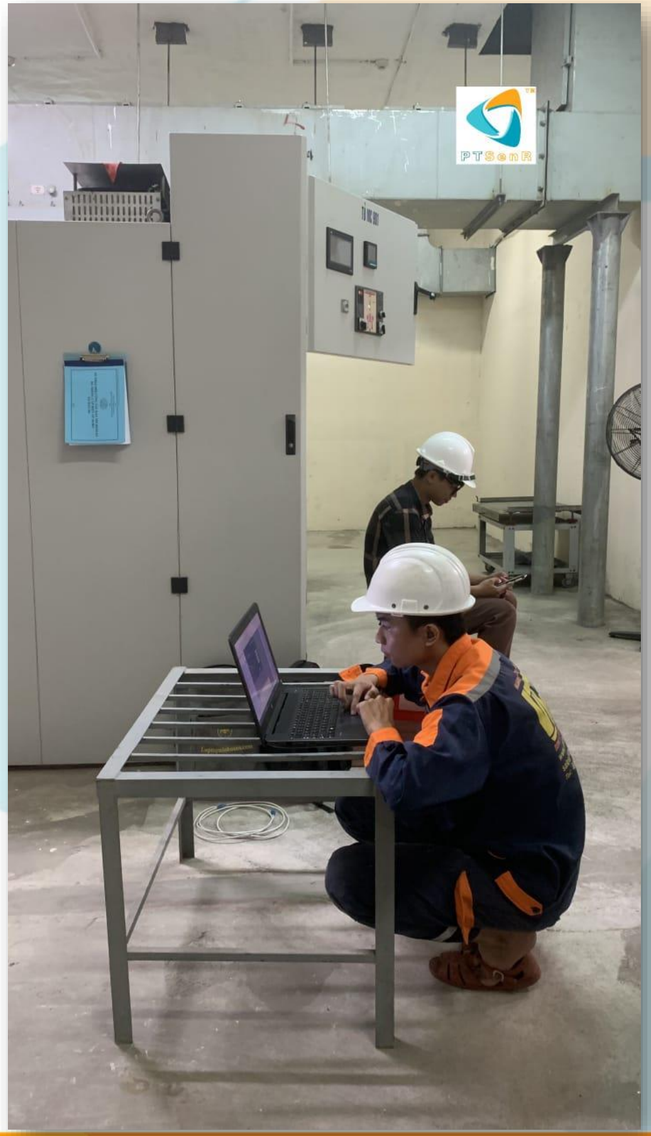




Hyundai Motor, Singapore
HV & LV Switchgear

Project Realization





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Project Realization

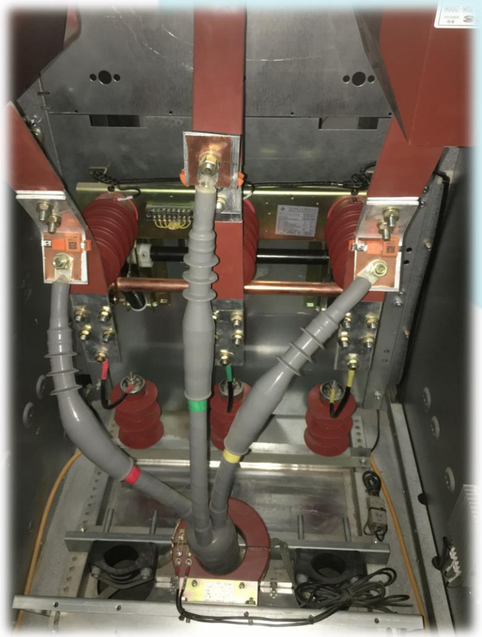
Myanmar Mandalay Conch Cement Production Line, Myanmar

What we did?

- ✓ PTSPS061 Temperature Sensor
- ✓ Digitalize the asset
- ✓ 100% uptime
- ✓ Optimise Operation

Application

- ✓ 36kV switchgear
- ✓ LV switchboard
- ✓ VCB termination
- ✓ Cable termination
- ✓ MCCB in & out



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Project Realization

Indonesia Hydro Power Plant, Indonesia

What we did?

- ✓ PTSPS061 Temperature
- ✓ PTSPD4000W 5in1 Partial Discharger Sensor
- ✓ PTSPS102
- ✓ Digitalize the asset
- ✓ 100% uptime
- ✓ Optimise Operation

Application

- ✓ 36kV switchgear
- ✓ VCB Tulip Connection
- ✓ Shipping Splits termination
- ✓ Cable Termination

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PTS™

IEC 60947-6-1:2021

Low-voltage switchgear and controlgear - Part 6-1: Multiple function equipment - Transfer switching equipment

RELIABILITY ENHANCE

SINGAPORE

MADE IN PTS

Agenda

Session 1: (Ray Khan)

- Roles of Multifunction Equipment – Transfer Switching Equipment
- Overview IEC 60947-6-1
- Classes of ATS
- Control Methods
- Coordination of ATS
- Transfer Types
- Q&A

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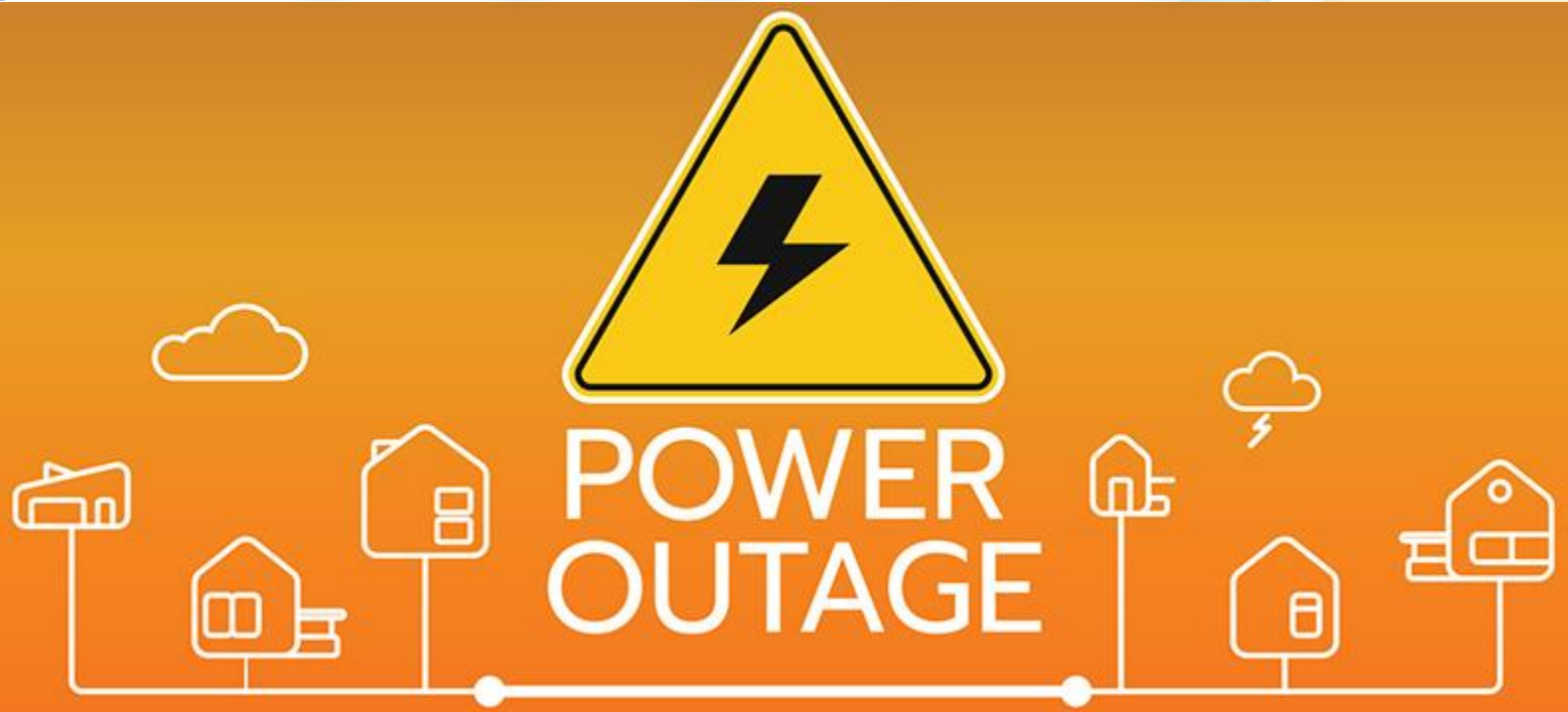
COST of



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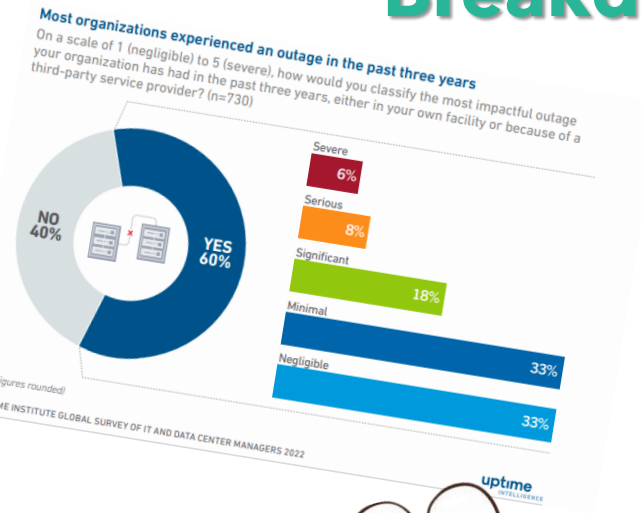
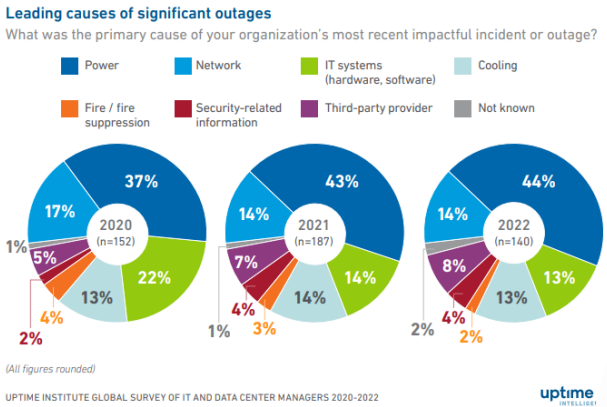
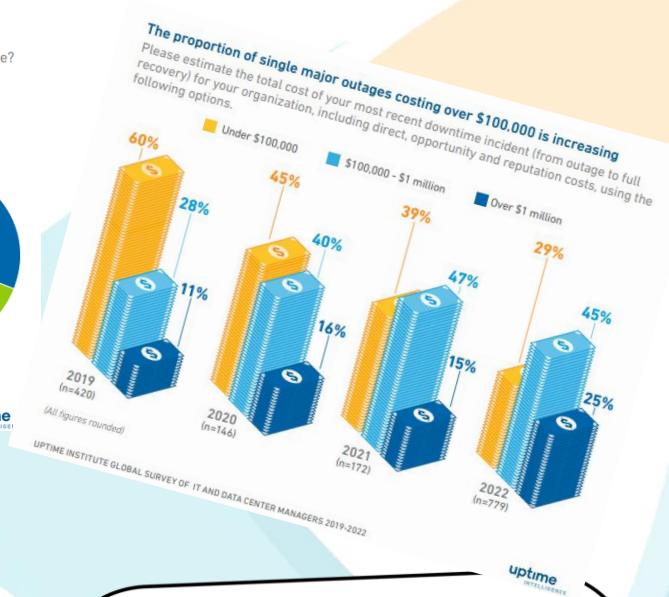
Breakdown of Outages


Most organizations experienced an outage in the past three years
On a scale of 1 (negligible) to 5 (severe), how would you classify the most impactful outage your organization has had in the past three years, either in your own facility or because of a third-party service provider? (n=730)
NO 40%
YES 60%
Severe 6%
Serious 8%
Significant 18%
Minimal 33%
Negligible 33%
igures rounded)
HE INSTITUTE GLOBAL SURVEY OF IT AND DATA CENTER MANAGERS 2022
uptime





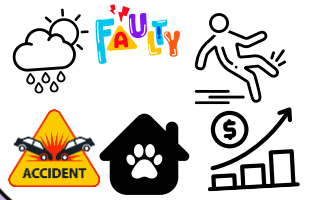
Average length of an outage:
86 Minutes

Average cost per incident:
$690,204

That is
$8,026/min!!!

- **Lost Productivity**
- **Development Delays**
- **Lost Revenue**
- **Lost Customer Confidence**
- **Lost Business to Competitors**

Most common causes outage



Weather
Faulty equipment
Human Factor

Motor
Accidents
Animals
Over Demand
Cyber Crime

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Emergency Standby Power.

Why are they Necessary

- Electricity is essential to every part of the Installation
- When we lose power
  - All equipment will not function Except equipment supported by UPS
  - lights go out (Except E-Lighting power by Battery Pack)
  - Motor will stop (Elevator, Electrical Fire water pump, Exhaust System, Cooling System)
- When we lose power without Emergency Back Up system can cause us to Lose of Income/Opportunity, a dangerous situation and Possibly life-threatening situation.

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Emergency Standby Power.

What are the Important Components/ Equipment in Emergency Standby Power

- Stand By Generator
- Fire Rated Cables for Fire fighting equipment
- Emergency Switchboard to provide power to equipment
- Automatic Transfer Switch to transfer the power from Normal Switchboard to Emergency Switchboard

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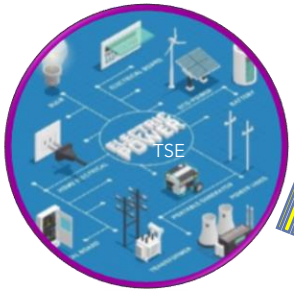
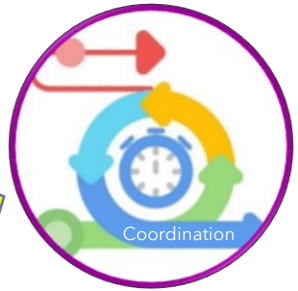
Key Roles and Functions of an ATS



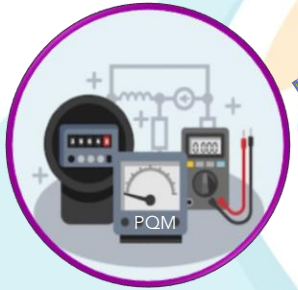
Power Source Transition

Load Distribution



Sequencing & Synchronization

Volt & Freq Monitoring



Remote Monitoring & Control

Load Shedding

Diagnostic & Reporting

Compatibility with Energy Management System

Compliance with International Standards

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IEC 60947-6-1 Overview

- ✓ Classification of an ATSE
- ✓ Utilization Categories
- ✓ Short circuit condition
- ✓ Making & Breaking Capacities
- ✓ Electrical & Mechanical Performance
- ✓ Electrical & Mechanical Interlock
- ✓ Utilization of use
- ✓ Temperature rise
- ✓ EMC Capabilities
- ✓ Harmonics
- ✓ Fast Transient Burst
- ✓ Performance Test
- ✓ Environmental Test

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IEC 60947-6-1: Introduction to Classification

3.3.6
Class PC TSE
transfer switch equipment based on mechanical switching devices, that do not need electrical power to hold the main contacts open or closed and capable of making, carrying, and breaking currents under normal circuit conditions including operating overload conditions, and making and withstanding short-circuit currents

Note 1 to entry: For the purposes of this document, a fuse-combination unit is considered a Class PC device capable of breaking short-circuit current.

Note 2 to entry: Class PC TSE are also capable of withstanding conditional short-circuit currents.

3.3.7
Class CB TSE
transfer switch equipment based on mechanical switching devices and capable of making, carrying and breaking currents under normal circuit conditions including operating overload conditions, and making and breaking short-circuit currents

Note 1 to entry: Class CB TSE for which the manufacturer has assigned a short-time withstand current are also capable of withstanding short-circuit currents.

3.3.8
Class CC TSE
transfer switch equipment based on mechanical switching devices having only one position of rest, operating otherwise than by hand, and capable of making, carrying and breaking currents under normal circuit conditions including operating overload conditions

Note 1 to entry: Class CC TSE are not capable of making or breaking short-circuit currents. They are only capable of withstanding conditional short-circuit currents.

Note 2 to entry: Class CC TSE is not suitable for isolation.

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Source changeover – 3 main categories

PC-Type

Switch or 2 x Switches

"A TSE (Transfer Switch Equipment) That is capable of making, withstanding but ***not intended for breaking short-circuit currents***

CC-Type

2 x non auto circuit-breakers or Contactors

"A TSE (Transfer Switch Equipment) That is capable of making, withstanding but ***not intended for breaking short-circuit currents****, and is* ***based on*** *devices fulfilling the requirements of IEC 60947-4-1" (aka* ***switches****)*

CB-Type

2 x circuit-breakers

"A TSE (Transfer Switch Equipment) That is capable of making, withstanding and ***intended for breaking short-circuit currents*** *and is to provide with overload current release"*

IEC 60947-6-1: Classification

3.3.6
Class PC TSE
transfer switch equipment based on mechanical switching devices, that do not need electrical power to hold the main contacts open or closed and capable of making, carrying, and breaking currents under normal circuit conditions including operating overload conditions, and making and withstanding short-circuit currents

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Note 2 to entry: Class CC TSE is not suitable for isolation.

PC-Type
Switch or 1 x Switches
"A TSE (Transfer Switch Equipment) That is capable of making, withstanding but ***not intended for breaking short-circuit currents***

IEC 60947-6-1: Classification

3.3.6
Class PC TSE
transfer switch equipment based on mechanical switching devices, that do not need electrical power to hold the main contacts open or closed and capable of making, carrying, and breaking currents under normal circuit conditions including operating overload conditions, and making and withstanding short-circuit currents

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Note 2 to entry: Class CC TSE is not suitable for isolation.

CB-Type
2 x circuit-breakers
*"A TSE (Transfer Switch Equipment) That is capable of making, withstanding and **intended for breaking short-circuit currents** and is to provide with overload current release"*

Controlled by the controller with mechanical interlocking electric transmission mechanism to realize the automatic conversion of two power supplies, switching time 1-2s."

IEC 60947-6-1: Classification

3.3.6
Class PC TSE
transfer switch equipment based on mechanical switching devices, that do not need electrical power to hold the main contacts open or closed and capable of making, carrying, and breaking currents under normal circuit conditions including operating overload conditions, and making and withstanding short-circuit currents

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Note 2 to entry: Class CC TSE is not suitable for isolation.

CC-Type
2 x non auto circuit-breakers or Contactors
*"A TSE (Transfer Switch Equipment) That is capable of making, withstanding but **not intended for breaking short-circuit currents**, and is **based on** devices fulfilling the requirements of IEC 60947-4-1"*

INTERNATIONAL STANDARD IEC 60947-6-1

Low Voltage Switchgear and Controlgear

- Part 6-1 (Transfer Switching Equipment)

3.3.4
automatic transfer switching equipment
ATSE
self-acting transfer switching equipment, including all necessary sensing inputs, monitoring, and control logic for transferring operations

Note 1 to entry: ATSE can have a feature for local and/or remote and/or manual operation.

3.3.5
derived transfer switching equipment
derived TSE
TSE based on switching devices tha ave certain tests required for compliance with IEC 60947-6-1 as defined in Table 9, covered by IEC 60947-3 for Class PC, IEC 60947-2 or IEC 60947-6-2 for Class CB, or IEC 60947-4-1 for Class CC

INTERNATIONAL STANDARD IEC 60947-6-1

Low Voltage Switchgear and Controlgear

Part 6-1 (Transfer Switching Equipment)

IEC Standards for Low Voltage Switchgear and Controlgear

- IEC 60947-1: General Rules
- IEC 60947-2 : Circuit Breakers
- IEC 60947-3 : Switches, Disconnectors, Switch Disconnectors and Fuse Combination Units
- IEC 60947-4 : Contactors and Motor Starters
- IEC 60947-5: Control Circuit Devices
- IEC 60947-6-1 : Transfer Switching Equipment

Class CB

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INTERNATIONAL STANDARD IEC 60947-6-1

Low Voltage Switchgear and Controlgear

Part 6-1 (Transfer Switching Equipment)

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- IEC 60947-4 : Contactors and Motor Starters
- IEC 60947-5: Control Circuit Devices
- IEC 60947-6-1 : Transfer Switching Equipment

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IEC 60947-6-1: Method Controlling

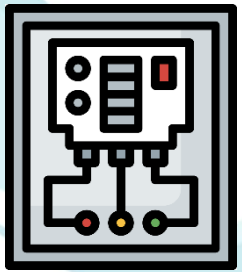
3.3.2
manually operated transfer switching equipment
MTSE
transfer switching equipment operated manually and non-electrically

3.3.3
remotely operated transfer switching equipment
RTSE
transfer switching equipment that is electrically operated and not self-acting

Note 1 to entry: RTSE can have a feature for local and/or manual operation.

3.3.4
automatic transfer switching equipment
ATSE
self-acting transfer switching equipment, including all necessary sensing inputs, monitoring, and control logic for transferring operations

Note 1 to entry: ATSE can have a feature for local and/or remote and/or manual operation.



c) the number of main contact positions:
   - TSE with two positions (I –II);
   - TSE with three positions (I – O –II);

d) their suitability for isolation:
   - TSE suitable for isolation in the OFF position;
   - TSE not suitable for isolation;

NOTE TSE having only two positions (I – II) and all Class CC TSE are not suitable for isolation.

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IEC 60947-6-1: Method Controlling

MTSE

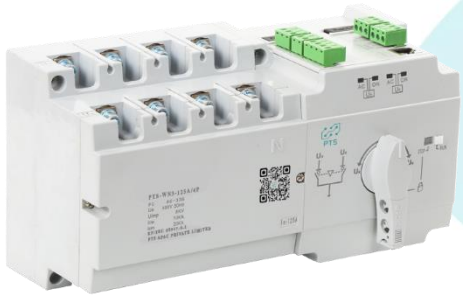
Physically Operate

Manually operated TSE

Feature: Manually operated mechanically.

RTSE

Signal Operate



Remotely operated TSE

Feature: remote operated, locally or manually, friendlywith system integration, wiring to controller room.

ATSE

Automatic operated TSE

Feature: Operate Local, Remote or Manually. self-acting, including microprocessor controller for sensing and transfer

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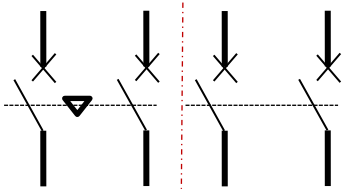
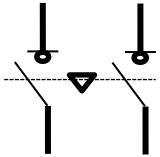
IEC Classification – Derived & Non-Derived

International Symbol

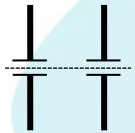
International Standard



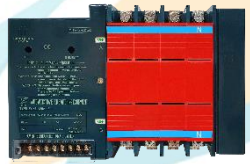
IEC 60947-2

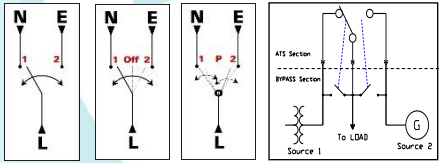


IEC 60947-3



IEC 60947-4





IEC 60947-6-1

IVM,IVE,Acc

Derived TSE

IVM,IVE,Acc

Derived TSE

IVM,IVE,Acc

Derived TSE

Non Derived TSE

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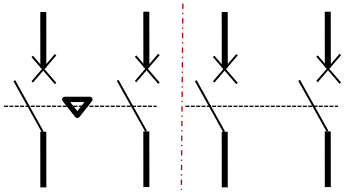
IEC Classification – Derived Solution

International Symbol



International Standard

IEC 60947-2

IVM,IVE,Acc

Derived TSE

IEC 60947-2:2020

Low-voltage switchgear and controlgear - Part 1: General rules
Low-voltage switchgear and controlgear - Part 2: Circuit Breakers

Things to Note:

- Electrical Panel need to be tested and certified accordance to the Brand & make of the Circuit Breaker to conform to the transfer switching requirement.

- Prevent unnecessary tripping of Circuit Breaker upon detection of Over/Fault Current downstream.
Designer need to ensure Coordination's Studies are diligently Done comparing the upstream and downstream circuit breaker.

- Downtime. With the inter-related integration of PLC/Relay with Circuit Breaker to achieve automatic switching functions, trouble shooting process becomes much complicated when failure occurs.

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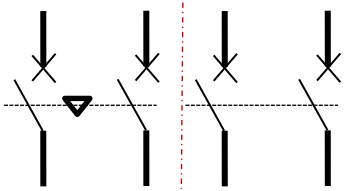
IEC Classification – Derived Solution

International Symbol

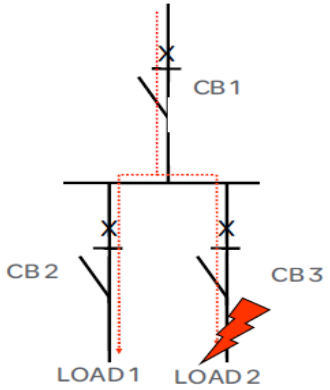


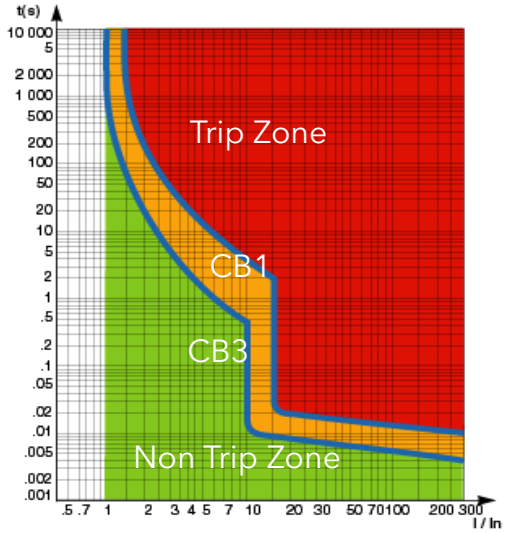
International Standard

IEC 60947-2

Derived TSE

Designer need to ensure Coordination's Studies are diligently done comparing the upstream and downstream circuit breaker.

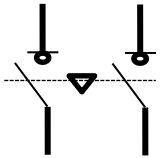




Circuit Breaker characteristic are describe by the time-current tripping curve

Time to trip will be according to the fault current value

IEC Classification – Derived Solution



IEC 60947-3

Derived TSE

IEC 60947-3:2020

Low-voltage switchgear and controlgear - Part 3: switch-disconnectors, switch-fuse units And circuit breakers

Things to Note:

- This design are only for Manual Switching

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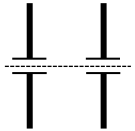
IEC Classification – Derived Solution



IEC 60947-4

IVM,IVE,Acc

Derived TSE

IEC 60947-4:2020

Low-voltage switchgear and controlgear - Part 4: Contactors and motor starters; electromechanical contactors and motor starters

Things to Note:

- Electrical Panel need to be tested and certified accordance to the Brand & make of the Contactor conform to the transfer switching requirement.

- Downtime. With the inter related design of PLC/Relay and Circuit Breaker to achieve automatic switching Trouble shooting process becomes much complicated.

- Contactor lacks high current making capabilities.

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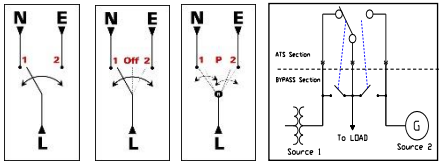
IEC Classification – Non-Derived Solution



IEC 60947-6-1

Non Derived TSE

IEC 60947-6-1:2021

Low-voltage switchgear and controlgear - Part 6: Multi-function switchgear and controlgear - Mains switches (categories AC-33A/B)

Things to Note:

- This code is designed for Switching Equipment

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IEC 60947-6-1: Tripping Limits and Characteristics

9.2.3.4 Tripping limits and characteristics

The tripping limits and characteristics of CB type TSE shall be verified according to 8.3.3.2 of IEC 60947-2:2016, IEC 60947-2:2016/AMD1:2019.

IEC

IEC 60947-2

Edition 5.0 2016-06

Low-voltage switchgear and controlgear –
Part 2: Circuit-breakers

8.3.3.2 Test of tripping limits and characteristics

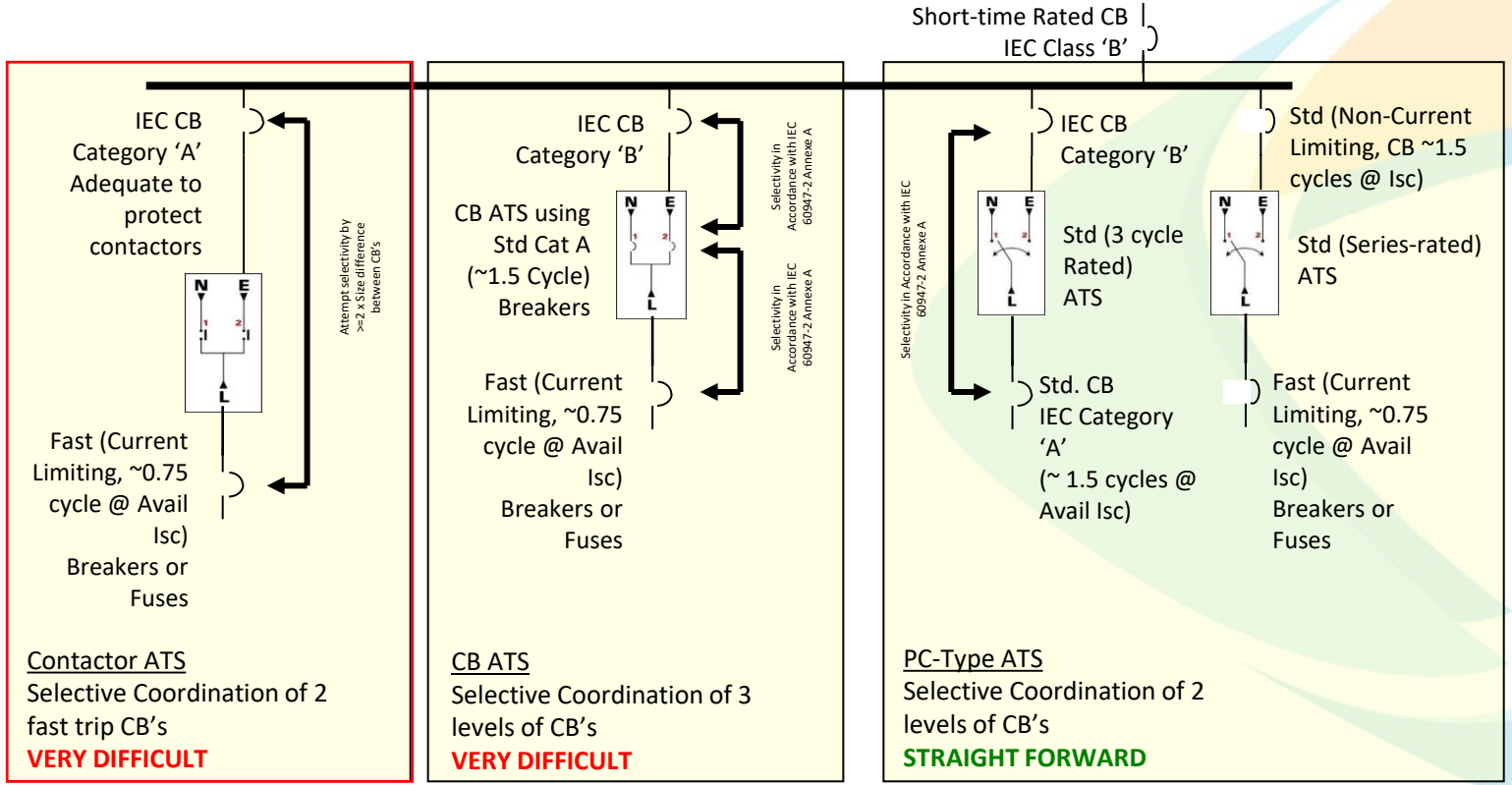
8.3.3.2.1 General

Subclause 8.3.3.2 of IEC 60947-1:2007/AMD1:2010/AMD2:2014 is amplified as follows:

The ambient air temperature shall be measured as for the temperature-rise tests (see 8.3.2.5).

When the over-current opening release is normally a built-in part of the circuit-breaker, it shall be verified inside the corresponding circuit-breaker.

Coordination Selection CB vs PC type of TSE



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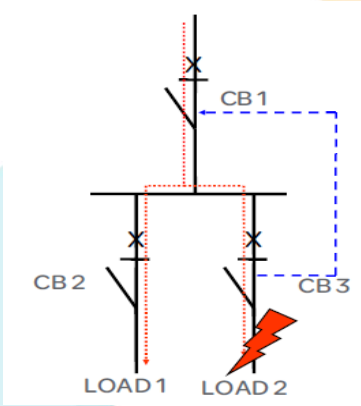
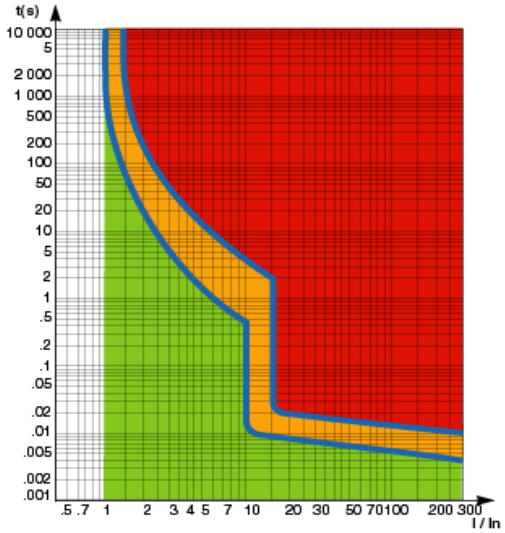
IEC 60947-6-1: Tripping Limits and Characteristics

Designer need to ensure Coordination's Studies are diligently done comparing the upstream and downstream circuit breaker.





Circuit Breaker characteristic are describe by the time-current tripping curve

Time to trip will be according to the fault current value

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INTERNATIONAL STANDARD IEC 60947-6-1

Low Voltage Switchgear and Controlgear

- Classification of Transition Types

3.4.7
open transition
a break before make transfer operation that intentionally breaks the load current from one source for a period of time prior to making it to the other source

3.4.8
in-phase transfer
control function of an ATSE to only allow an open transition transfer when the two sources are considered in phase, at the same voltage and frequency

3.4.9
closed transition
a make before break transfer operation that intentionally makes the load current of a second synchronized source for a short period of time before breaking it from the first source

3.4.10
interlocking
<TSE> feature(s) that make(s) the state of two mechanisms mutually exclusive, preventing any of the phases of source I and source II from being connected together

Note 1 to entry: Interlocking prevents the closed position of switching devices to be simultaneously achieved under all conditions. The state of two mechanisms mutually dependent prevents the change of position of operation of one mechanism depending on the position of operation of the other.

INTERNATIONAL STANDARD IEC 60947-6-1

Low Voltage Switchgear and Controlgear

- In-Phase Transfer

3.4.8
in-phase transfer
control function of an ATSE to only allow an open transition transfer when the two sources are considered in phase, at the same voltage and frequency

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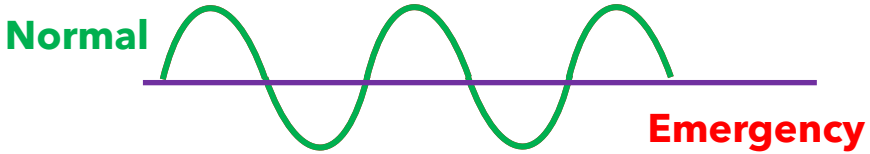
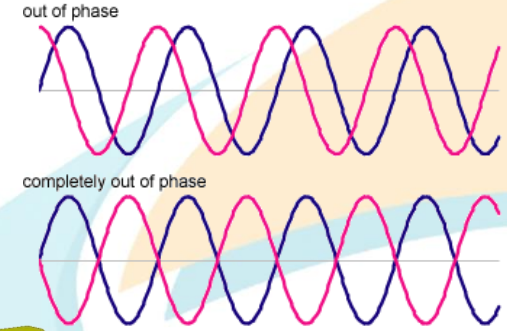
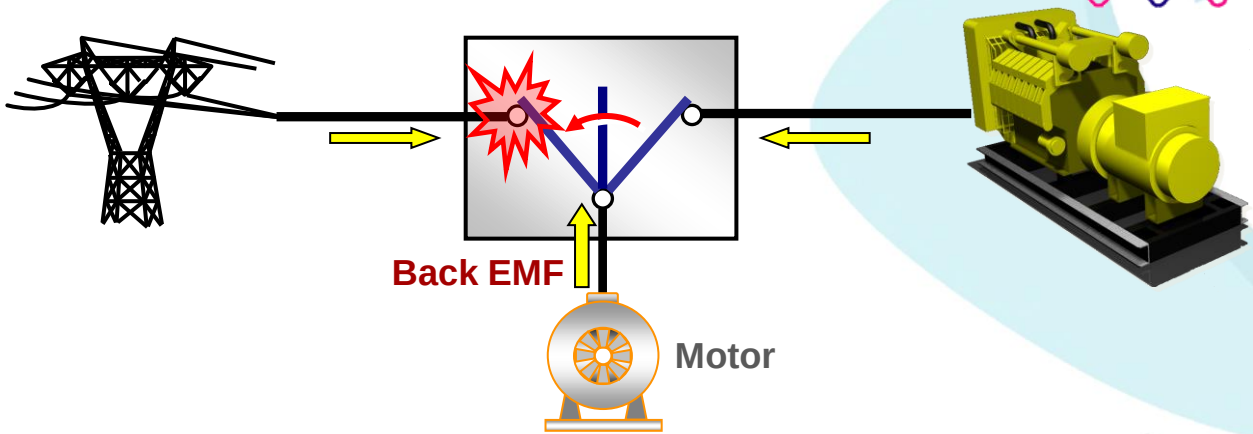
Transferring Motors – OTTS without in-phase



Phase diff=180°





The inrush current can go up to **MAX 18 time** the starting current of motor cause the CB trip or even damage the Motor

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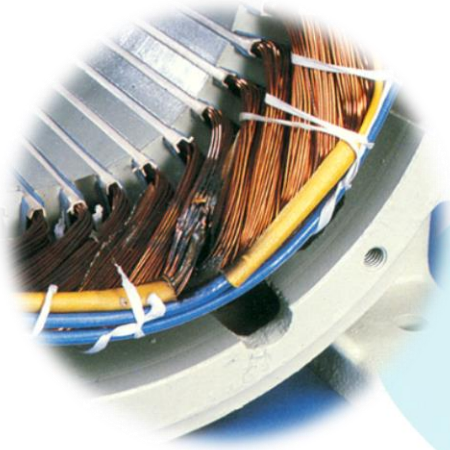
Problem Caused by Random Transfer of Motor Load

- Breaker trips due to high induced currents



- Motor insulation damage due to voltage transients

- Motor shaft and coupling damage due to mechanical stress

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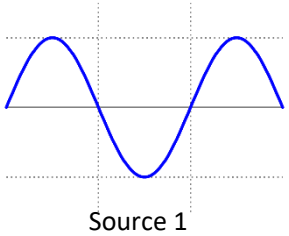
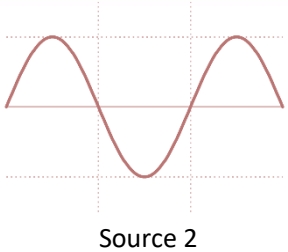
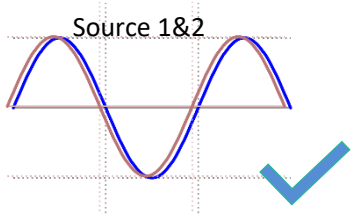
In-Phase Transfer



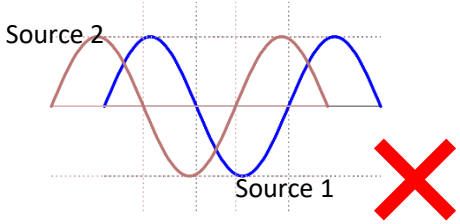


Scenario 1: Acceptable Window of Sync Achieved. Controller trigger signal to ATS to Transfer to Alternate Source



Scenario 2: In-Phase/Sync Check Function not seeing acceptable Window limits between 2 source

Controller stop ATS from Transferring to Alternate Source



What does in-phase transfer require?

- A repeatably fast Transfer Switch (3-5 cycles)
- A consistently fast, reliable operating solenoid mechanism
- Reliable microprocessor controls complete with passive synchro scope (0-30deg)

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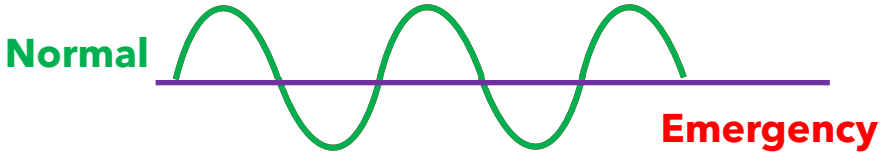
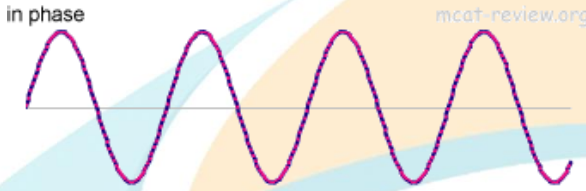
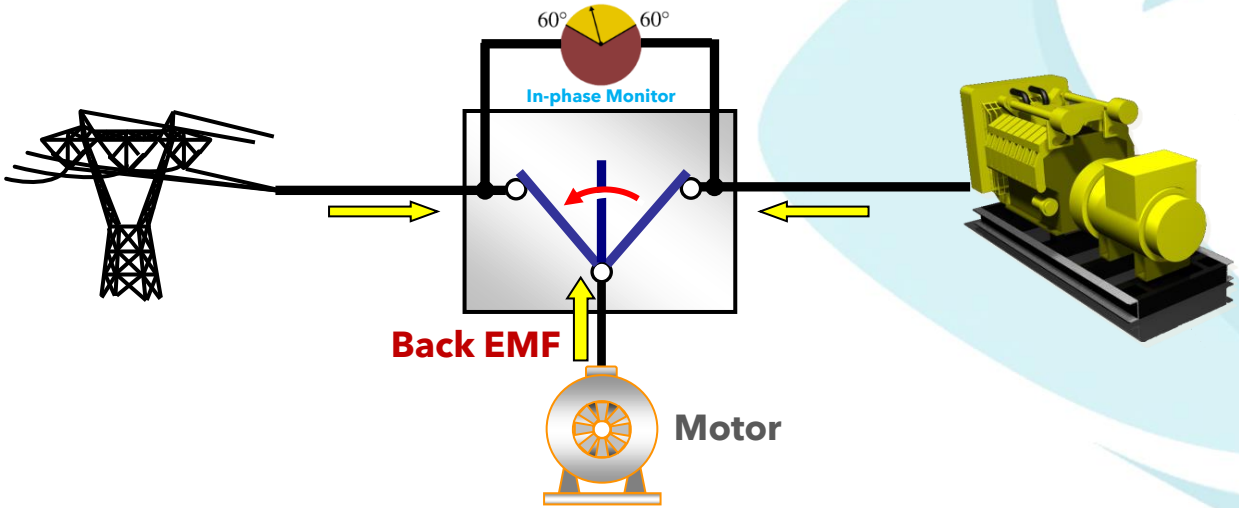
Transferring Motors – OTTS with in-phase



Phase diff=15°





The inrush current is limited **< 6 time** starting current of motor by the function of ***In-phase Monitor***

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What is the differences between In-Sync vs In-Phase Transfer?

In-Phase Transfer

- In phase Monitor only for Open Transition
- Set to OFF by Default
- When Enabled, Controller will disallow transfer of load from one live source to another live source until the in-phase conditions are met
- Phase Angle Must not be +/- 60 electrical degrees
- Frequency not more then +/- 3Hz
- In Phase Transfer is useful for Motor Loads (Usually has large Phase Angle Difference) which will draw large inrush current during switching causing breakers to trip.

In-Sync Transfer

- In Sync Monitor only for Close Transition
- It has more stringent requirement because 2 live source are momentarily paralleled during transfer,
- Phase Angle Difference must be less than +/- 5 Electrical Degree
- Frequency not more then +/- 0/2Hz
- Voltage Difference must be less then 5%
- In Sync Transfer for Close Transition provide zero interruption during transfer between 2 live source.

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PTS-WN3 Series

Opened / Delay Transition

- Slow Transfer / Delay Transfer also know Break Before Make (BBM)
- Transfer or retransfer there's always a interruption to the load.
- Under-voltages, over-voltages, over-frequency, under- frequency and voltage drop conditions

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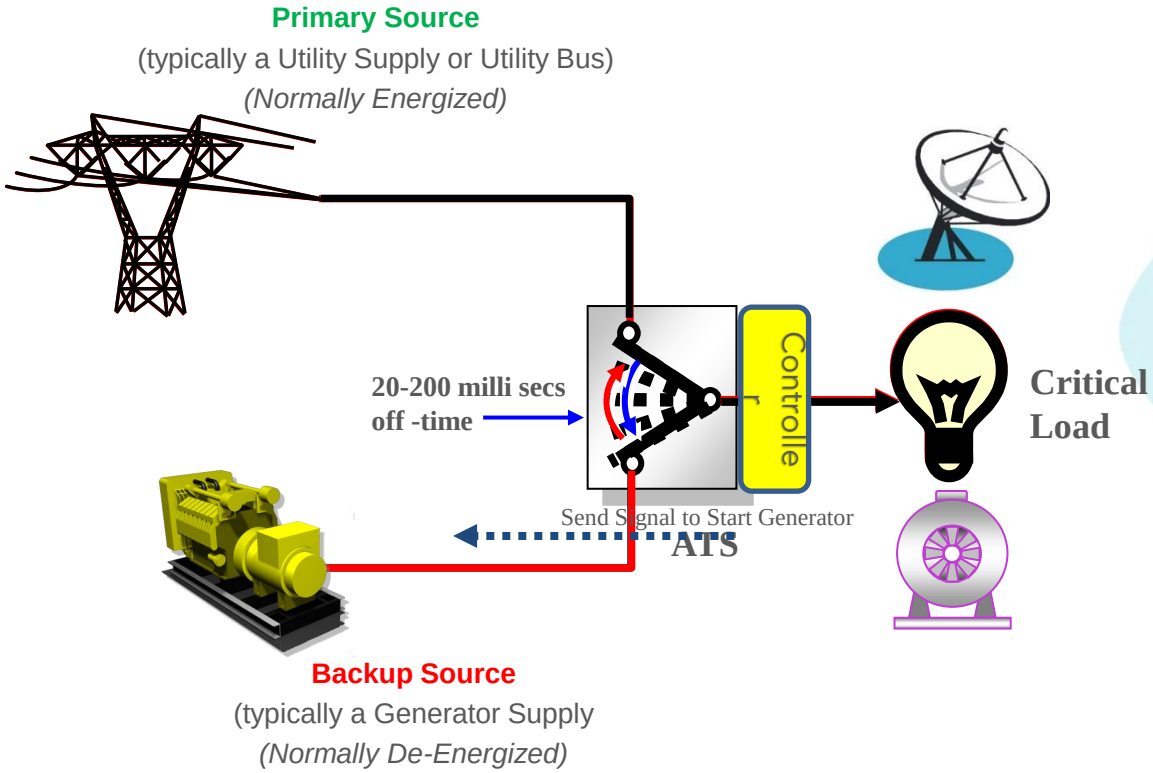
Open Transition (Break Before Make) Operation



BREAK BEFORE MAKE (BBM)

- One set of contacts open before the other set close;
- Load is disconnected from power during all transfers;
- Fast Break Fast Make

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PTS-WN3 Series

Opened Transition with / without overlapping neutral

- Built-in or add-in Phase-angle and sync-check relay.
- Phase-angle relay senses that the residual voltages and alternative source voltage are in-phase or within the limits of the out-of-phase conditions.

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PTS-WS1 Hybrid

Fast Transfer with in-phase

- Incorporates using of fast-acting, stored – energy breaker (such as 5cycles or less clearing time).
- Do not have time delay. The Transfer is based on the assumption that the two source are in synchronism.
- Phase-angle relay senses that the residual voltages and alternative source voltage are in-phase or within the limits of the out-of-phase conditions.
- Defined in ANSI C50.41 [B2] as on that occurs with in 10cycles

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PTS-WN3BCT- 5000A-4P
Closed Transition Transfer Switches
with Maintenance Bypass

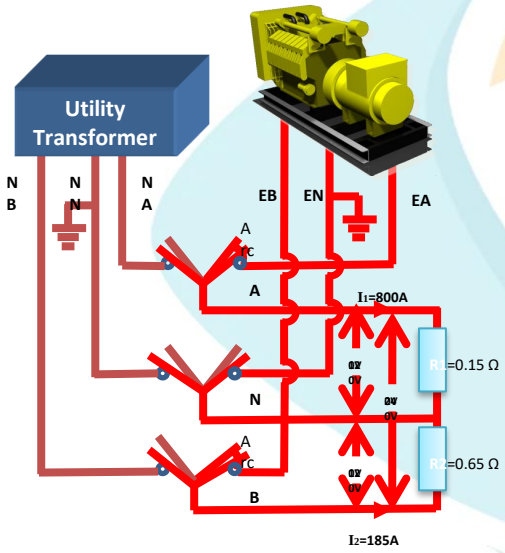
PTS-WN3MCT-1000A-3P
Manual Closed Transition Transfer
Switches with Exetherm Infrared sensors.

PTS-WN3CT-630A-4P
Closed Transition Transfer Switches

Ampere Interrupting Capacity (AIC) Ratings

Ampere Rating	16-125	160-250	300-630	800-1250	1600-2600	3200-6300
Utilization Category	AC-33A/B	AC-33A/B	AC-33A/B	AC-33A/B	AC-33A/B	AC-33A/B
Withstand Short Time Rating (kA)	25 - 35	25 - 35	50 - 65	65 - 80	80 - 100	80 - 100
Rated conditional sho-rt circuit current (kA) FUSE	200	200	200	200	200	200
Low Voltage (A)	AC690/400	AC690/400	AC690/400	AC690/400	AC690/400	AC690/400
Impulse withstand voltage (kV)	8	8	8	8	8	8
Rated insulation voltage (V)	1000	1000	1000	1000	1000	1000

OVERLAPPING NEUTRAL EXPLAINED



Single Phase 3 Wire System

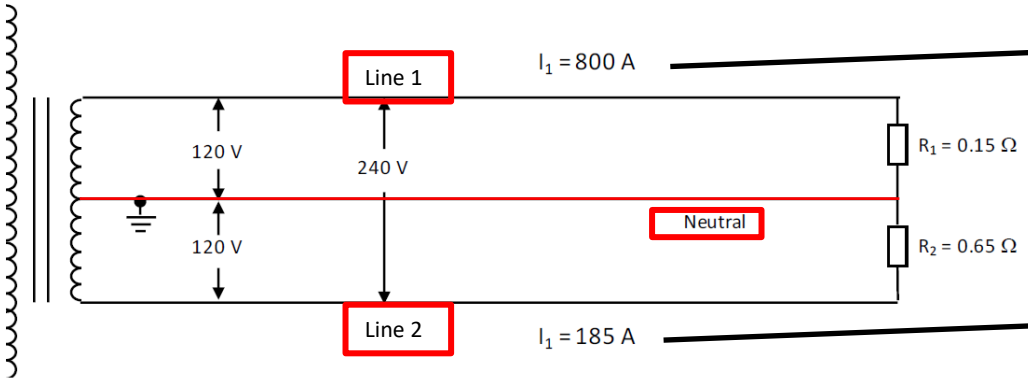


Figure 10: Voltage on each phase is equal when the neutral is present.

V=IR
120V = I x 0.15 Ohms
I1= 800A

V=IR
120V = I x 0.65 Ohms
I2 = 185A

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Single Phase 3 Wire System

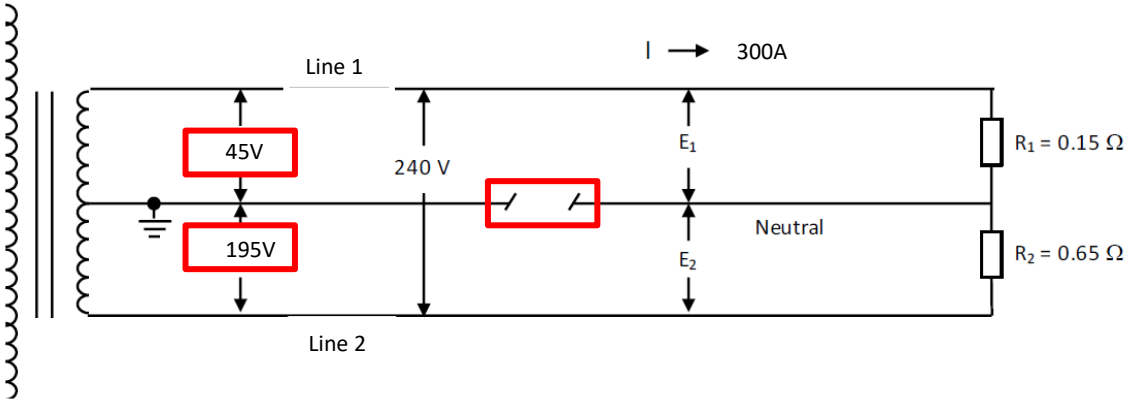


Figure 11: Breaking the neutral results in different voltages on each phase when different amounts of load are present.

$$I = \frac{E}{R} = \frac{240\ V}{0.15+0.65\ \Omega} = 300\ A$$

$$E_1 = 300A \times 0.15\Omega = 45\ V$$

$$E_2 = 300A \times 0.65\Omega = 195\ V$$

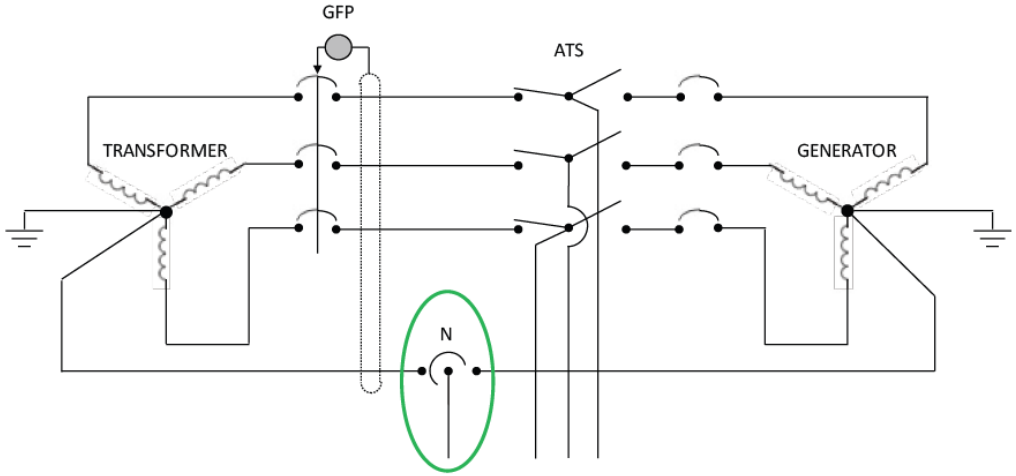
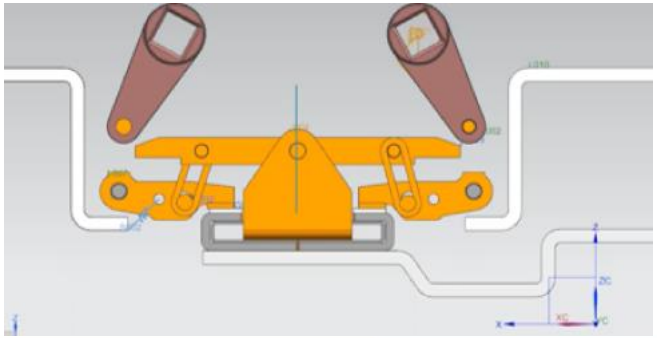


Figure 13: A four pole ATS equipped with overlapping neutral contacts.



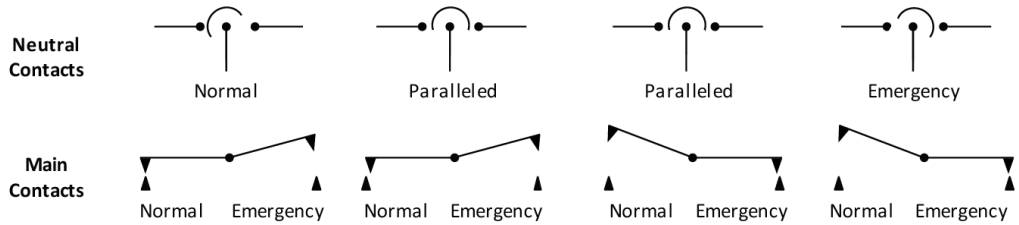
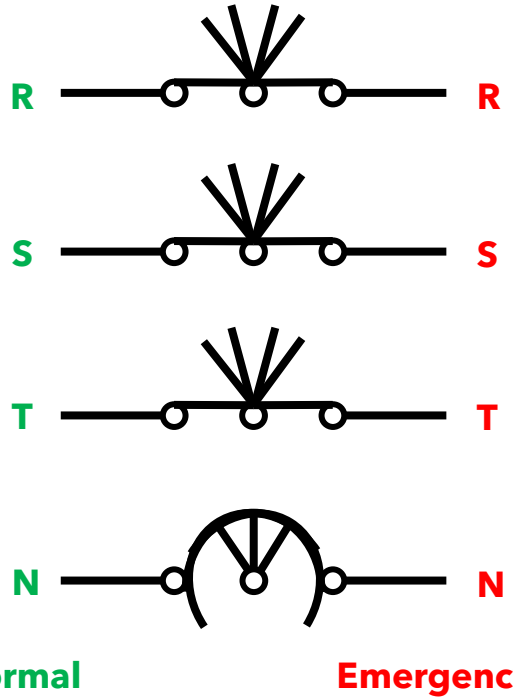
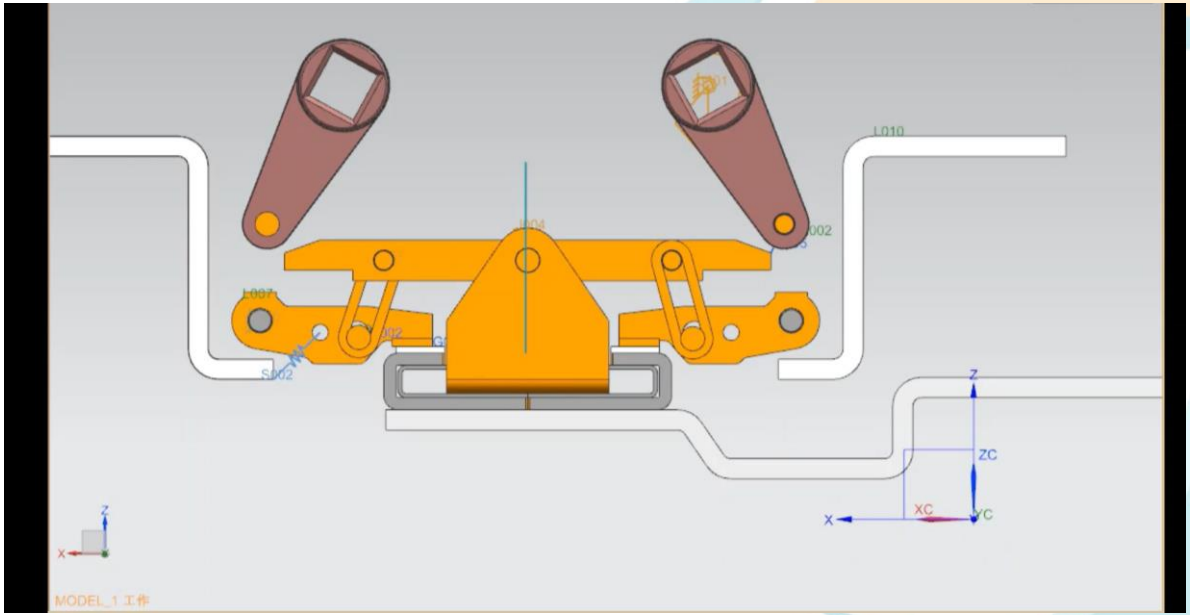


Figure 14: Sequence for switching from Normal to Emergency using overlapping neutral contacts.

Overlapping Neutral - Operations





PTS-WN3 Series CTTS

Closed Transition with synchronization

- Parallel Fast Transfer also known as Make Before Break (MBB)
- Source are **momentarily paralleling <100msec. between** alternative and normal sources.
  - ✓ Voltages **±5%**
  - ✓ Frequency **±0.2hz**
  - ✓ Electrical Phase degree **±5°**

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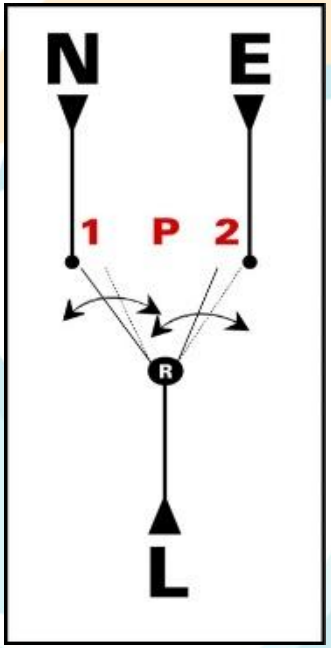
PTS-WN3 Closed Transition – Make Before Break

Body

Brains

Schematic Symbol



Monitor & Control

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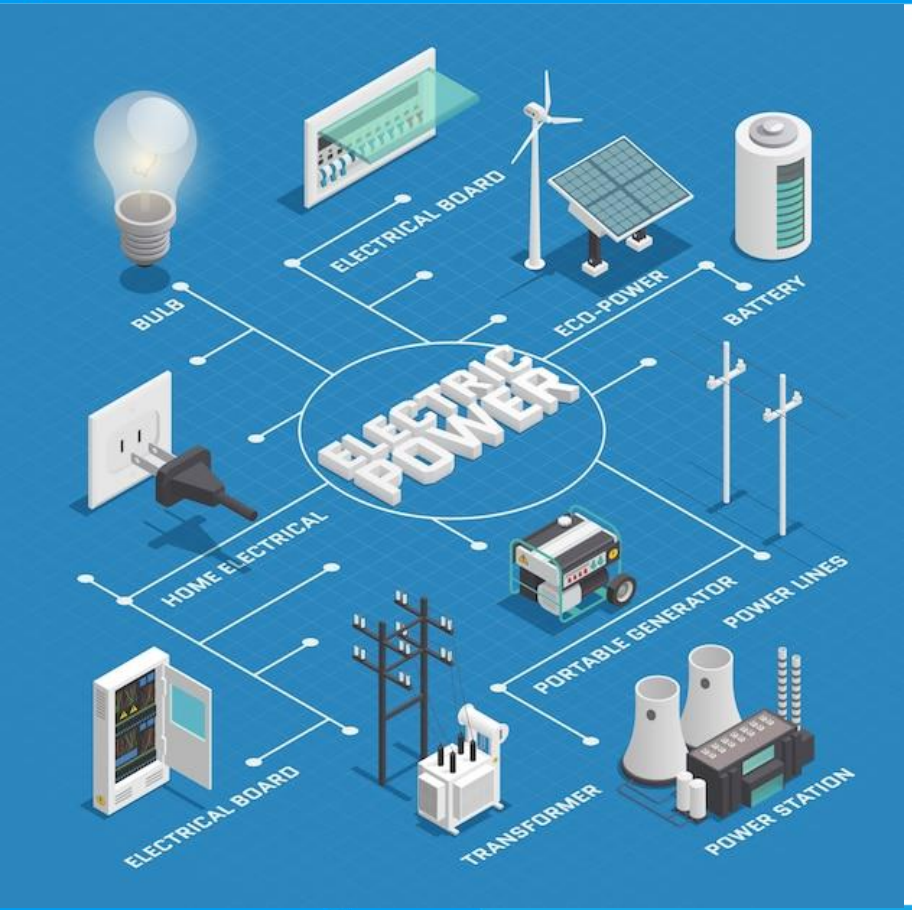

Make before Break switching criteria:-

- Sources are momentarily connected (<100msec)
  (IEEE Transaction on Power Delivery)
- Requires dual operator (solenoid) TS mechanism one for normal and one for emergency.
- Requires isochronous/electronic type governor
- Requires source to be "in synchronization"

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Confidential

Windows of Synchronization

PTS-WST-9 Microprocessor controller build in with **PASSIVE** synchroscope

- Requires source to be "in sync"
  - ✓ **+/- 5%** voltage differential
  - ✓ **+/-0.2** Hz freq. differential
  - ✓ **+/- 5°** degrees phase angle differential

❖ If these three requirements are not met, closed transition transfer will be inhibited (2mins)

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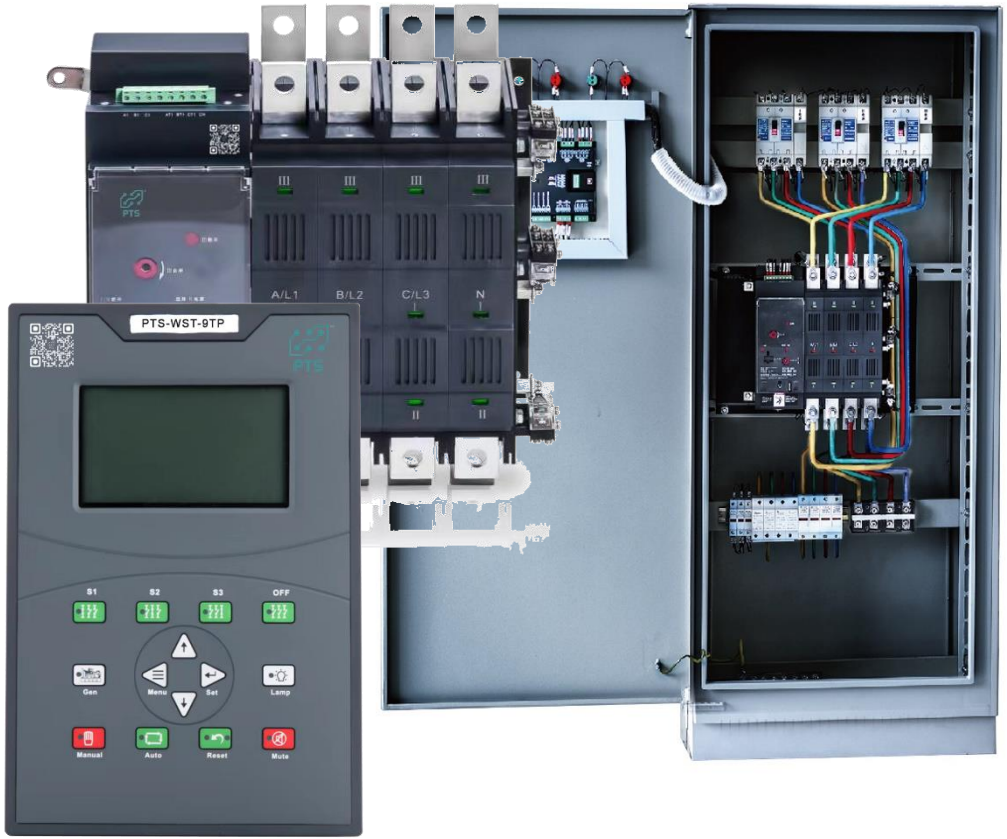
PTS-W3 Series – 3 incoming Sources ATS



Opened Transition

- 1 Utility, 2 Genset
- 2 utility, 1 Genset

- **Intelligent microprocessor:** 3-way sequency operation, Under-voltages, over-voltages, over-frequency, under-frequency and voltage drop conditions

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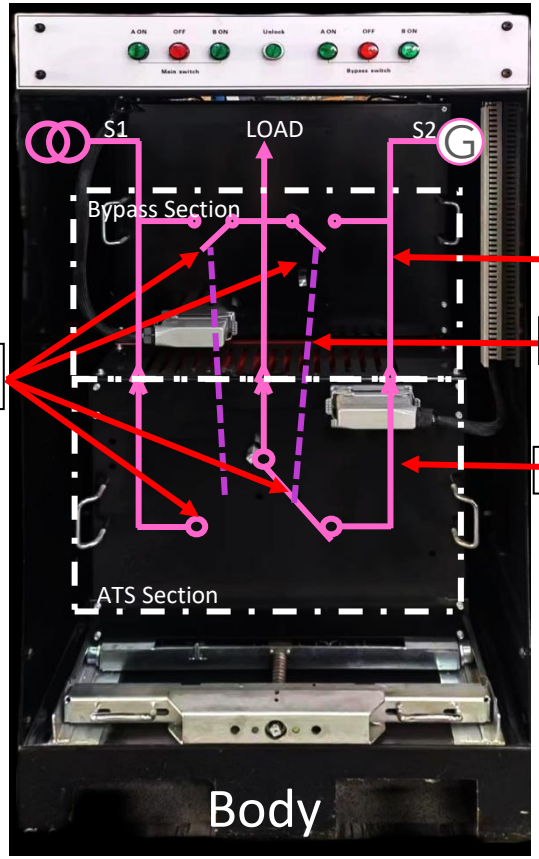
PTS-WN3 Bypass Isolation Series - Maintenance



Two Way Bypass – S1 & S2 to LOAD

FIXED MOUNT TS

MECHANICAL INTERLOCKS

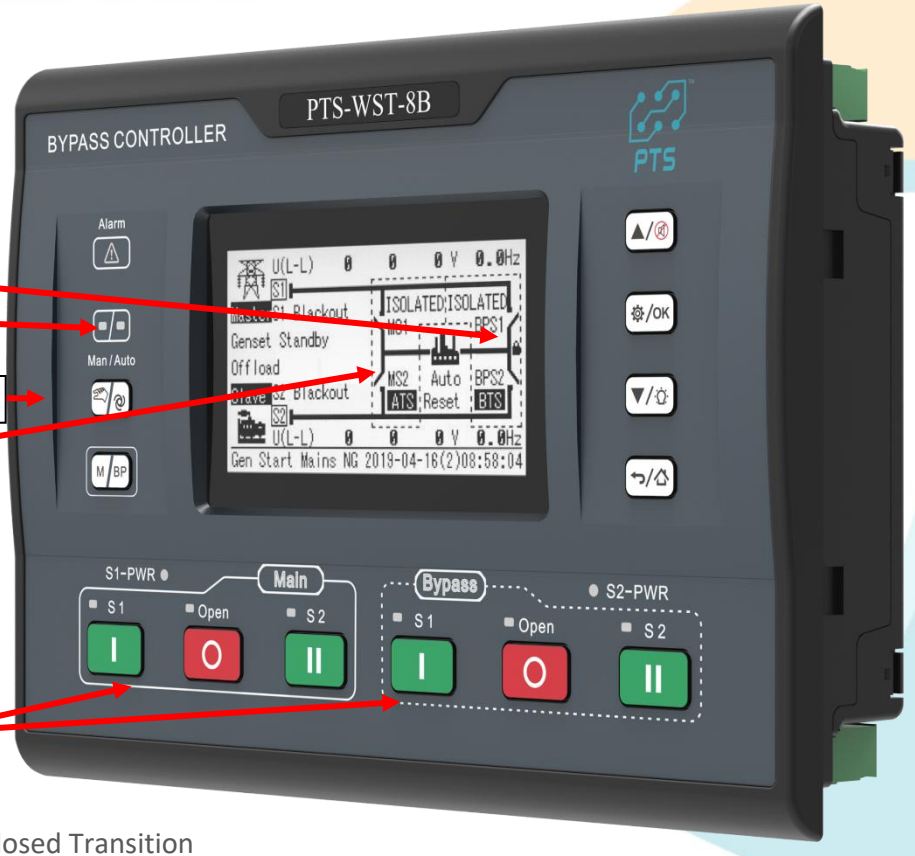
WITHDRAWABLE ATS

MAN / AUTO

ELECTRICAL INTERLOCKS

Monitor & Control

ELECTRICAL OPERATION



– Opened Transition / Closed Transition

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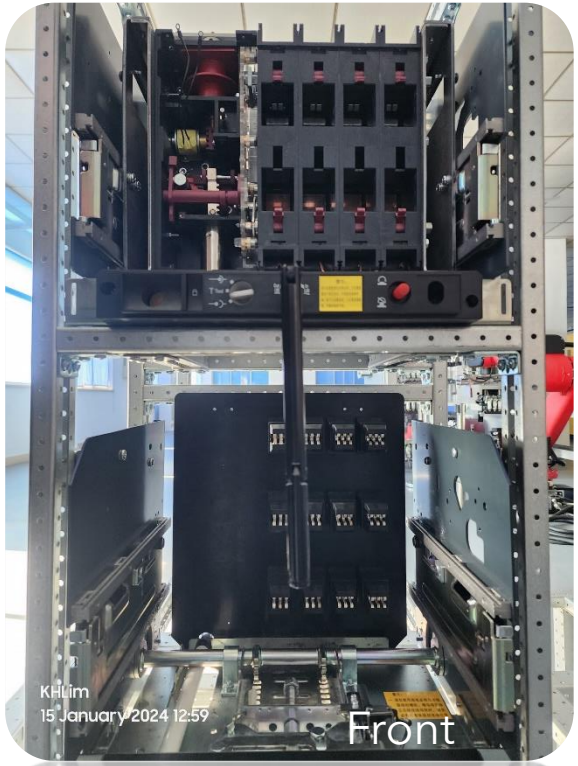
PTS-WN3 Bypass Isolation Series - Maintenance



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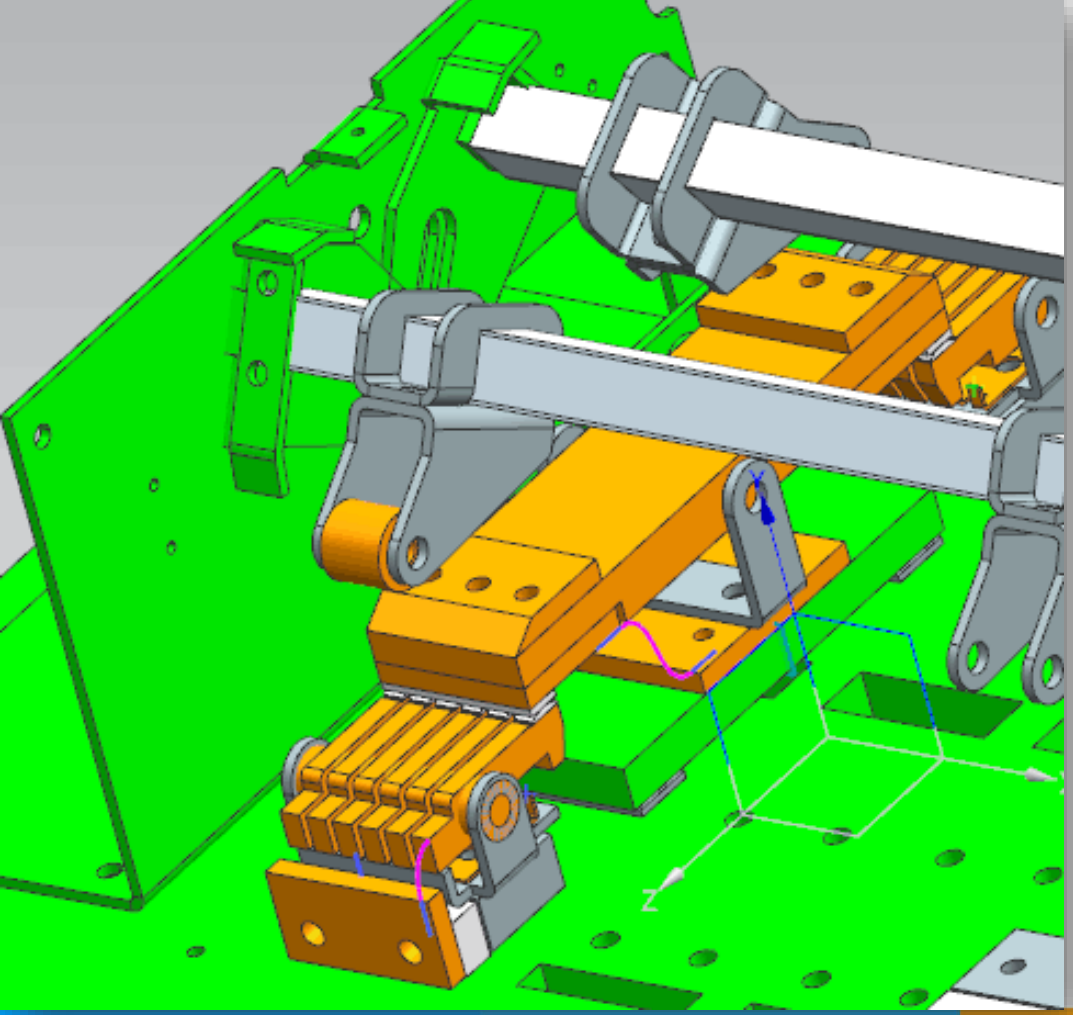

PTS Transfer Switch Design

- ✓ Why Selecting Solenoid
- ✓ Contact Composition
- ✓ Arc Chute
- ✓ Mechanical & Electrical Interlock

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Heart of Transfer Switch

- Fast Transfer Time, repeatable, true double-throw operation.
- Simplicity, Dependability, and easy maintainability because it has no motor, gears, or complicated mechanisms.
- The solenoid is never fused as some operators are. Fusing can render the transfer switch inoperable, an obviously undesirable feature for business-critical uses.

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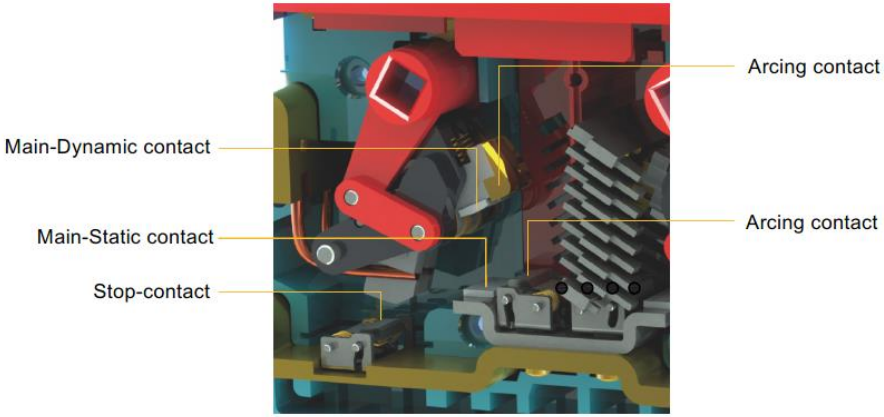
Contact Composition



CONTACT

- Contact Composition – Pure copper
- Silver Tungsten Alloy contacts plated
  - ✓Resists welding
  - ✓Enhanced withstand ratings
  - ✓Oxidization
- Movable contact assembly has 2 pieces, arcing contact and main current carrying contact.
- Arcing contacts make first, break last.

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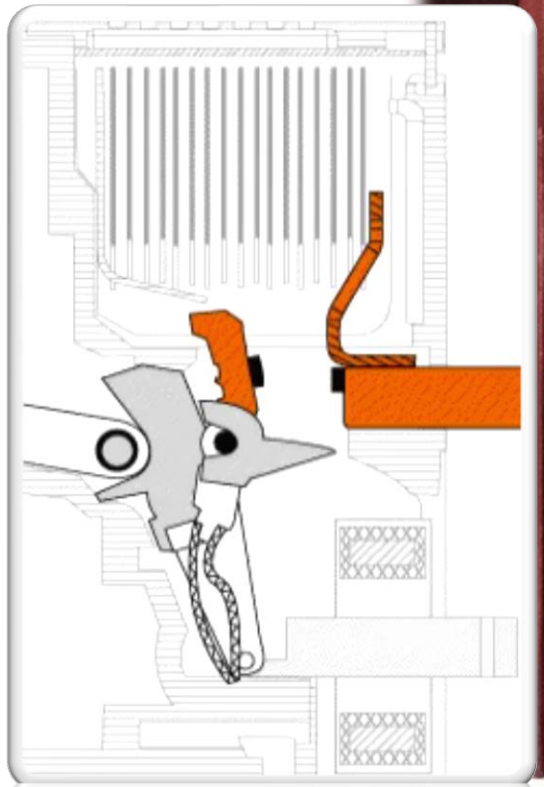
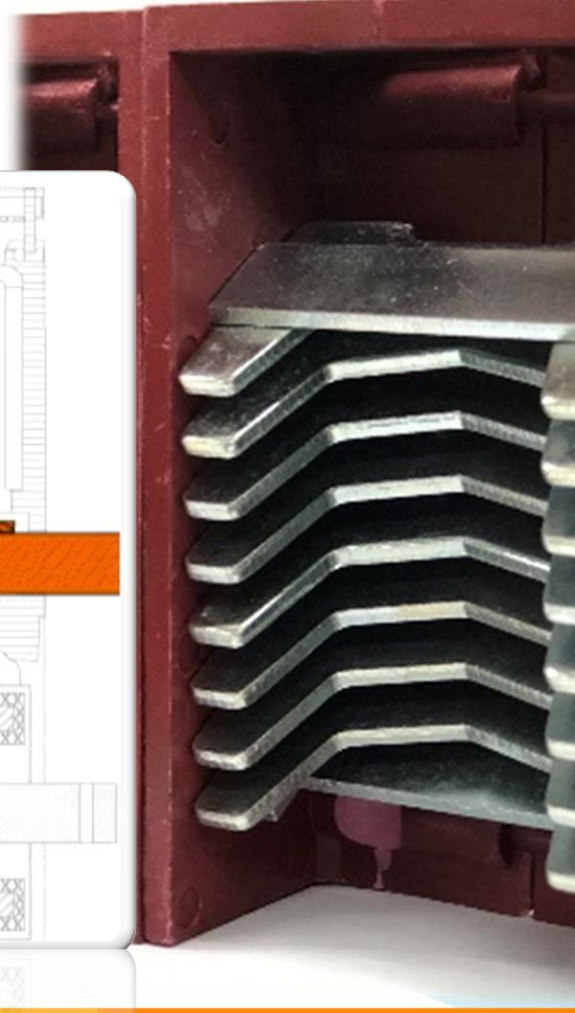
ARC Chutes

- Arc quenching grids & enclosed ARC chutes

- Material : -Thermosetting DMC
- excellent electrical properties,
- mechanical properties,
- heat resistance,
- chemical-resistant,

An arc chute - completely isolating arc-extinguishing ability more powerful flying into smaller arc.





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End

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